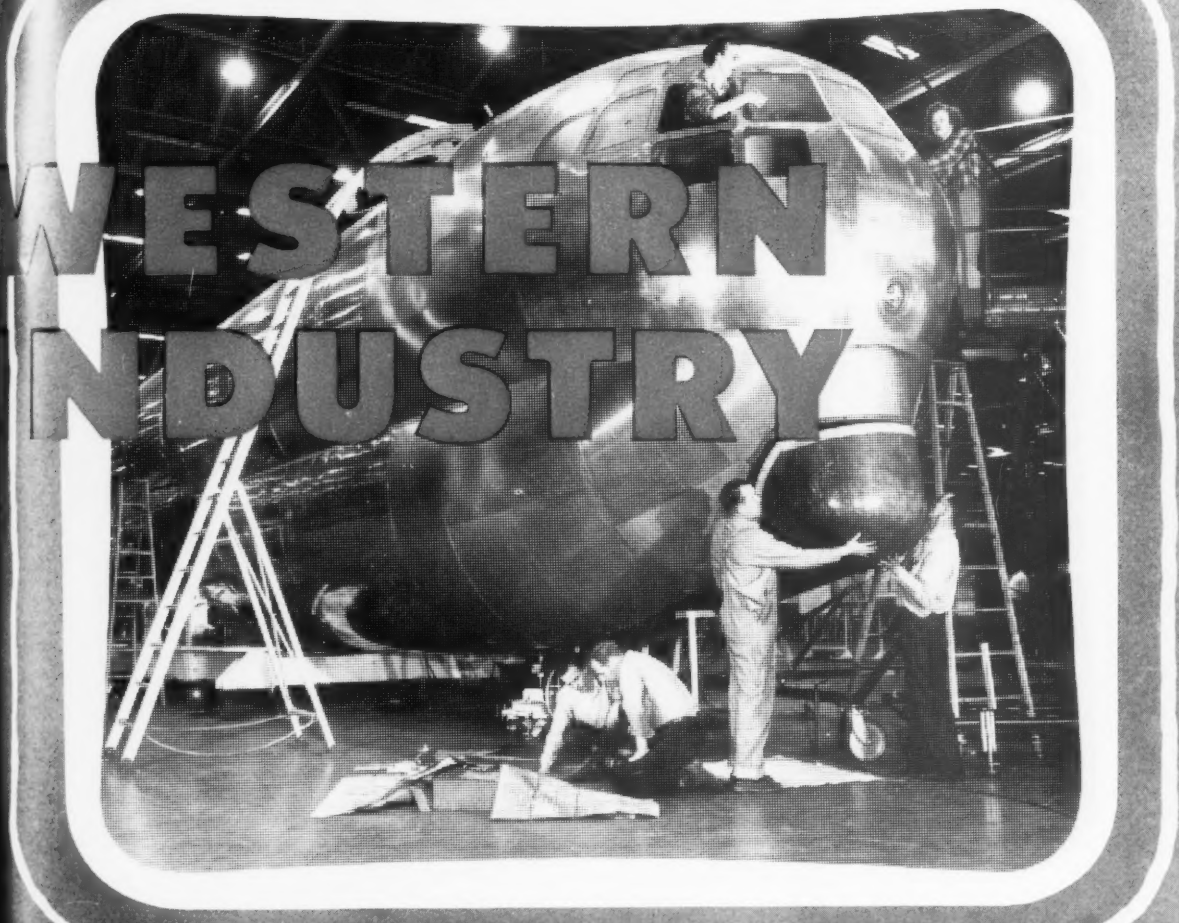
WESTERN INDUSTRY



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ND METALWORKING
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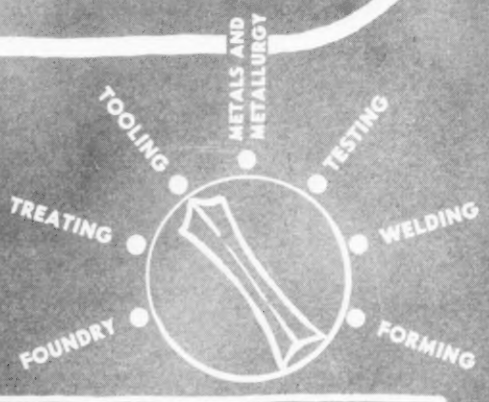

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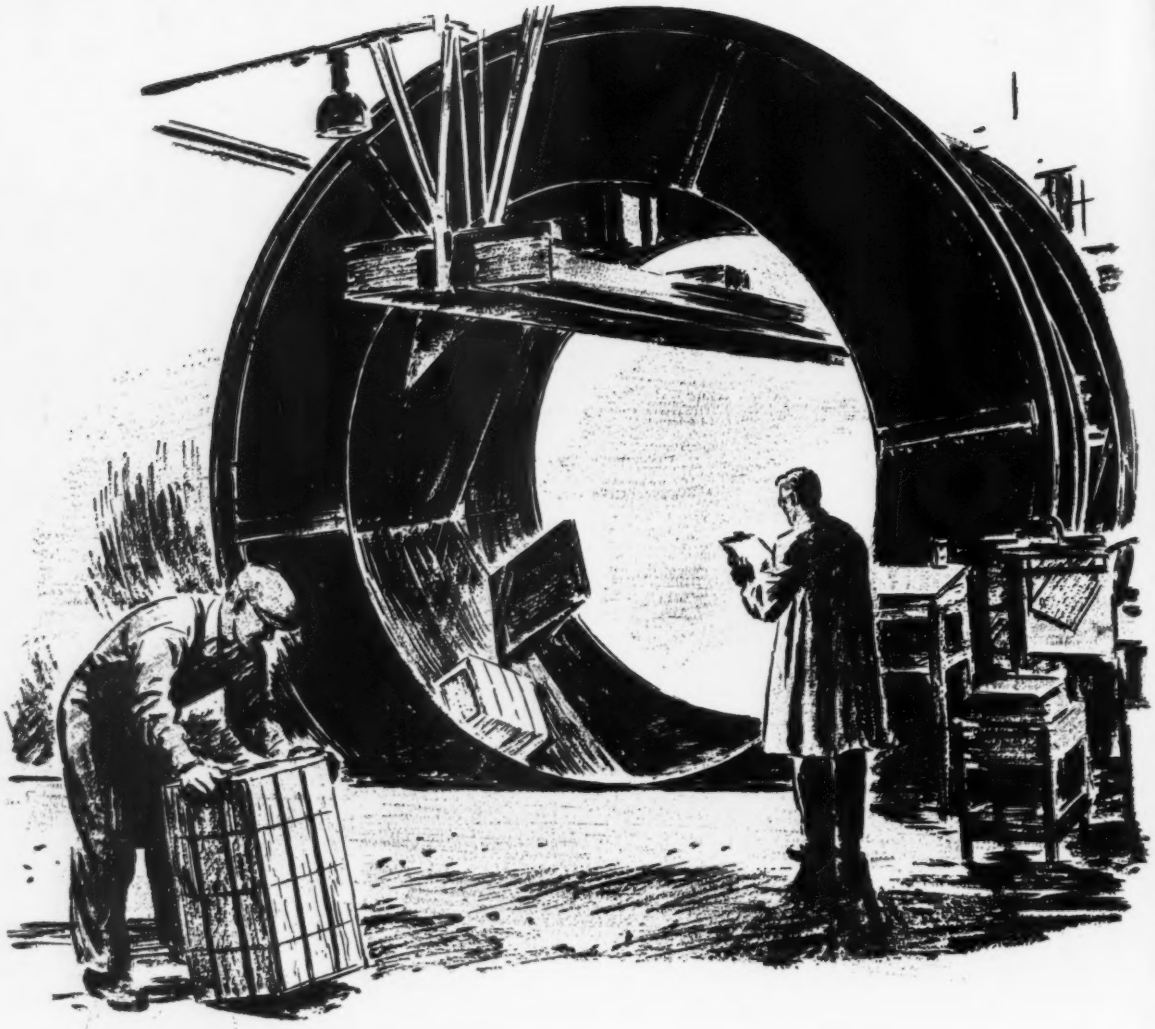
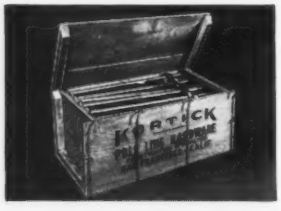
MARCH 1952





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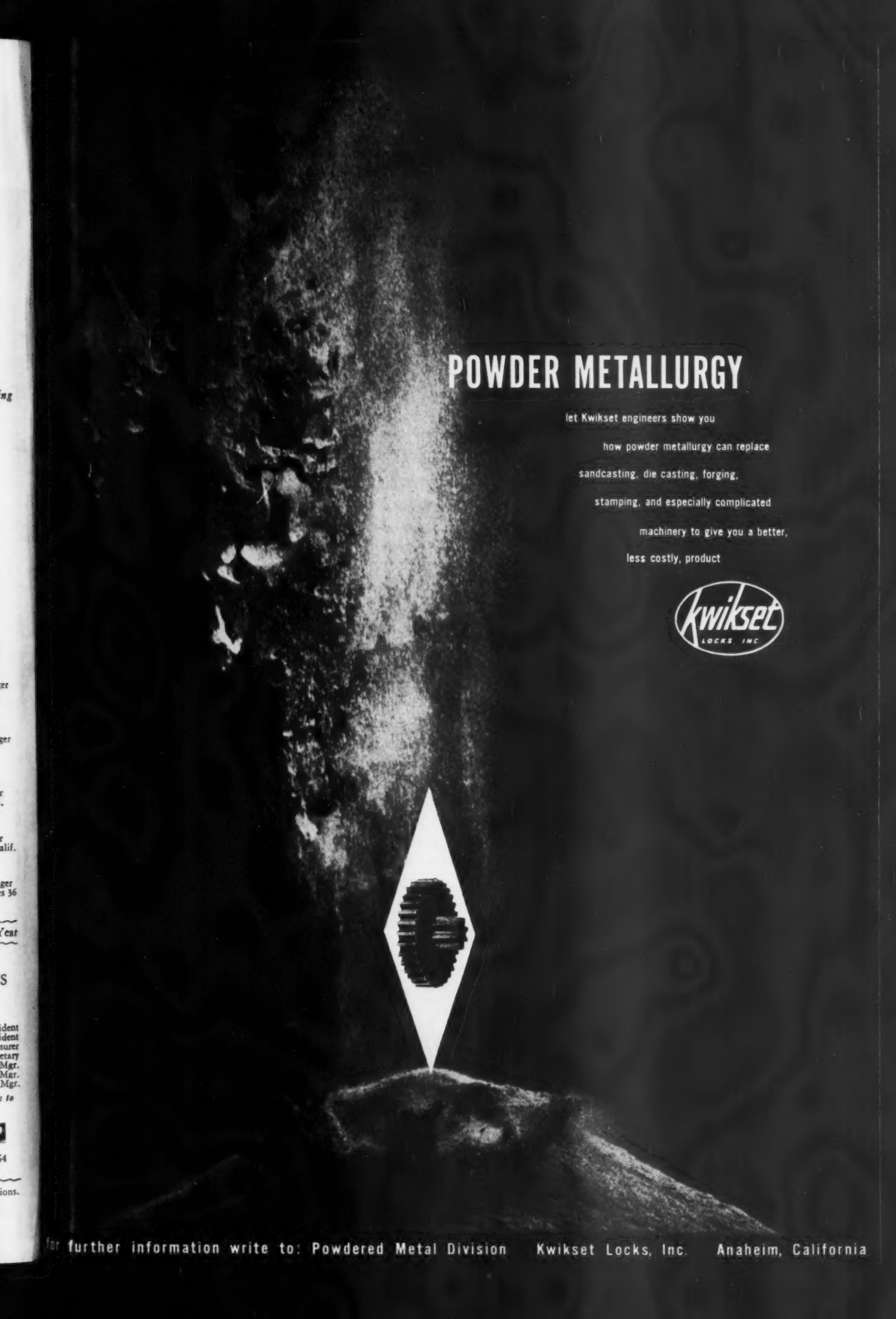
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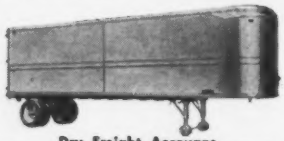

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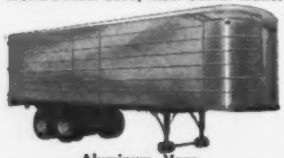

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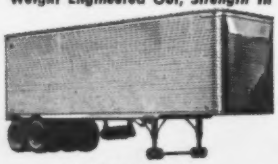
Weight Engineered Out, *Strength In*



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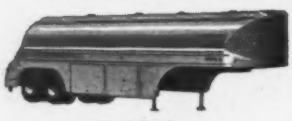

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DATA

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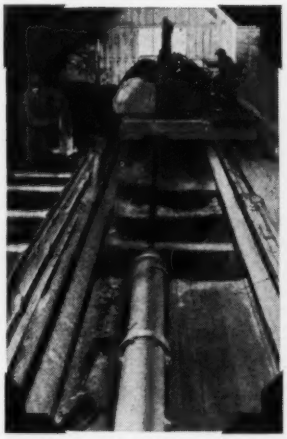
UNIT Bearings + air cylinders

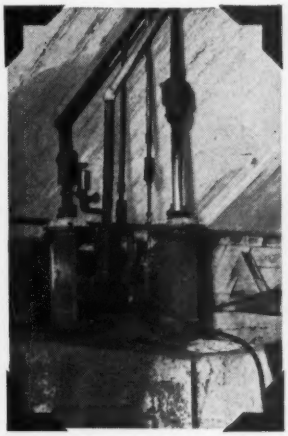
LUBRICATOR Mechanical-line feed

PERIOD 2½ years

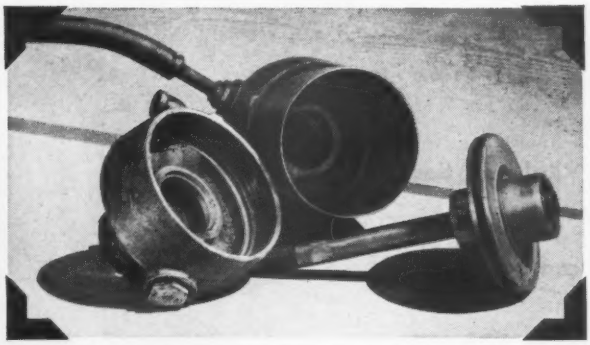
FIRM Mt. June Forest Products Co., Springfield, Oregon

Bearing- and air-power-cylinder trouble stopped by tacky oil!

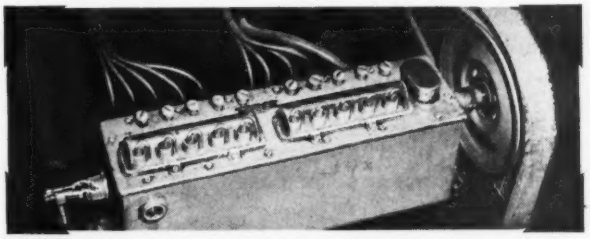




CALOL VISTAC OIL, lubricating the air "shotgun feed" and jacks (above) and all heavy-duty plain bearings in the Mt. June Forest Products Company sawmill, prevented any production delays due to lubrication in this mill's 2½ years of operation. "Using another brand under similar conditions at another mill I was constantly losing resaw bearings," says Ed Glaspey, Foreman.



THIS AIR CYLINDER AND PISTON, lubricated by Calol Vistac Oil, was in constant use in the mill for more than a year. Note the excellent condition of the cylinder walls and the neoprene seal on the piston.



A FORCE-FEED OILER supplied lubricant through lines to air units and bearings. Calol Vistac Oil may also be applied by drip-feed oilers and lighter grades by wick-feed and ring-oilers. It comes in grades to meet operating conditions in many industries.

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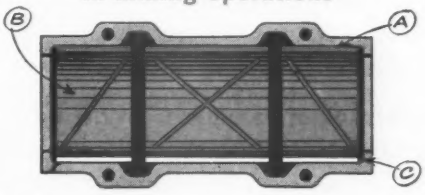
CALOL

How CALOL VISTAC Oil cuts costs in mining operations



Has wide use range in heavy-duty plain bearings operating in hard service, reduction gears, motor gear-heads, air cylinders, etc.; excellent air-tool lubricant—atomizes quickly and stays fluid at low temperatures.

A. Additives help form oily, pressure-resistant film...sticks on slow-moving parts and resists high temperatures.

B. Economical—small quantity will lubricate efficiently, dissipate heat.

C. Tenacious film cuts power loss and wear.

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STANDARD OIL COMPANY OF CALIFORNIA

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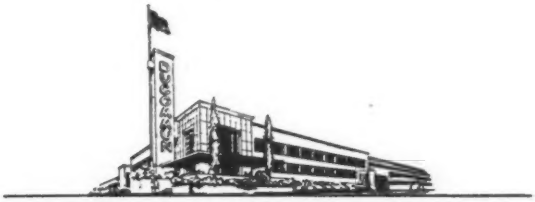

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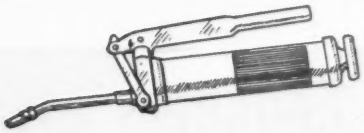

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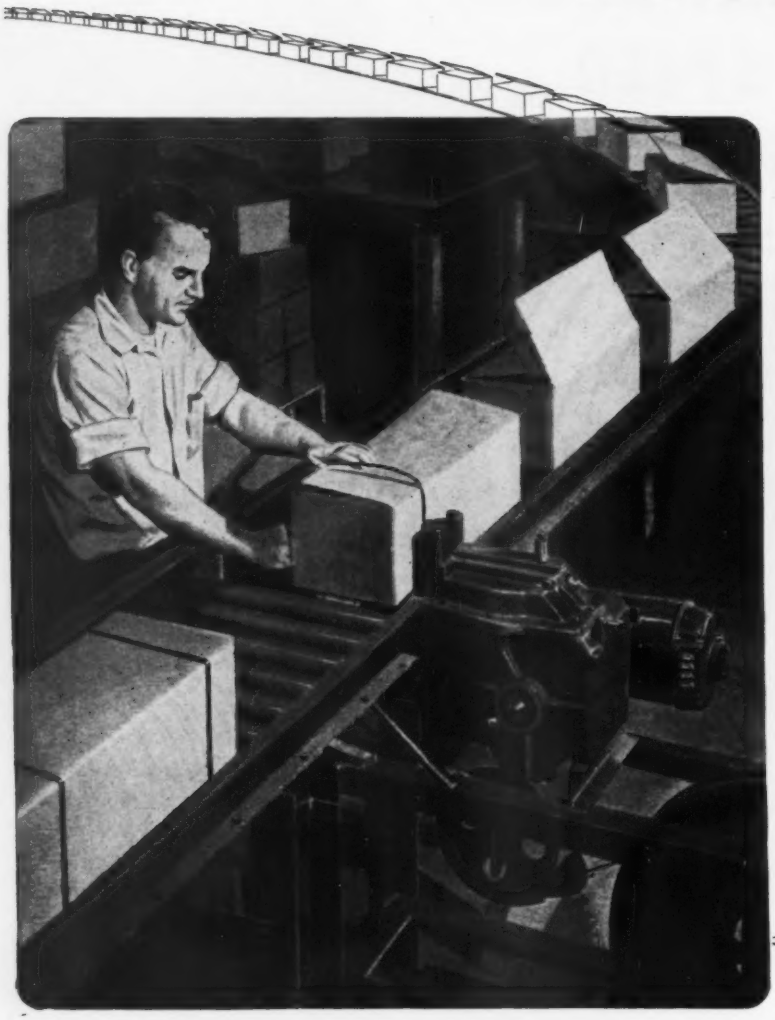

An eastern manufacturer, using Signode equipment, was turning out 560 packages every day. He was 100% satisfied. But the Signode field man in that territory wasn't. He was sure that he could step up the output of packages and reduce unit packaging costs with Signode's new Power Strapping Machine.

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versatile!

Uniformity is the word that best describes the strapping operation performed by a Signode Power Strapping Machine. Each strap is applied perfectly straight with *exactly* the same predetermined tension—even though your containers may vary somewhat in size and shape. Result: every container looks neat and is securely protected.

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this seal means security in shipping

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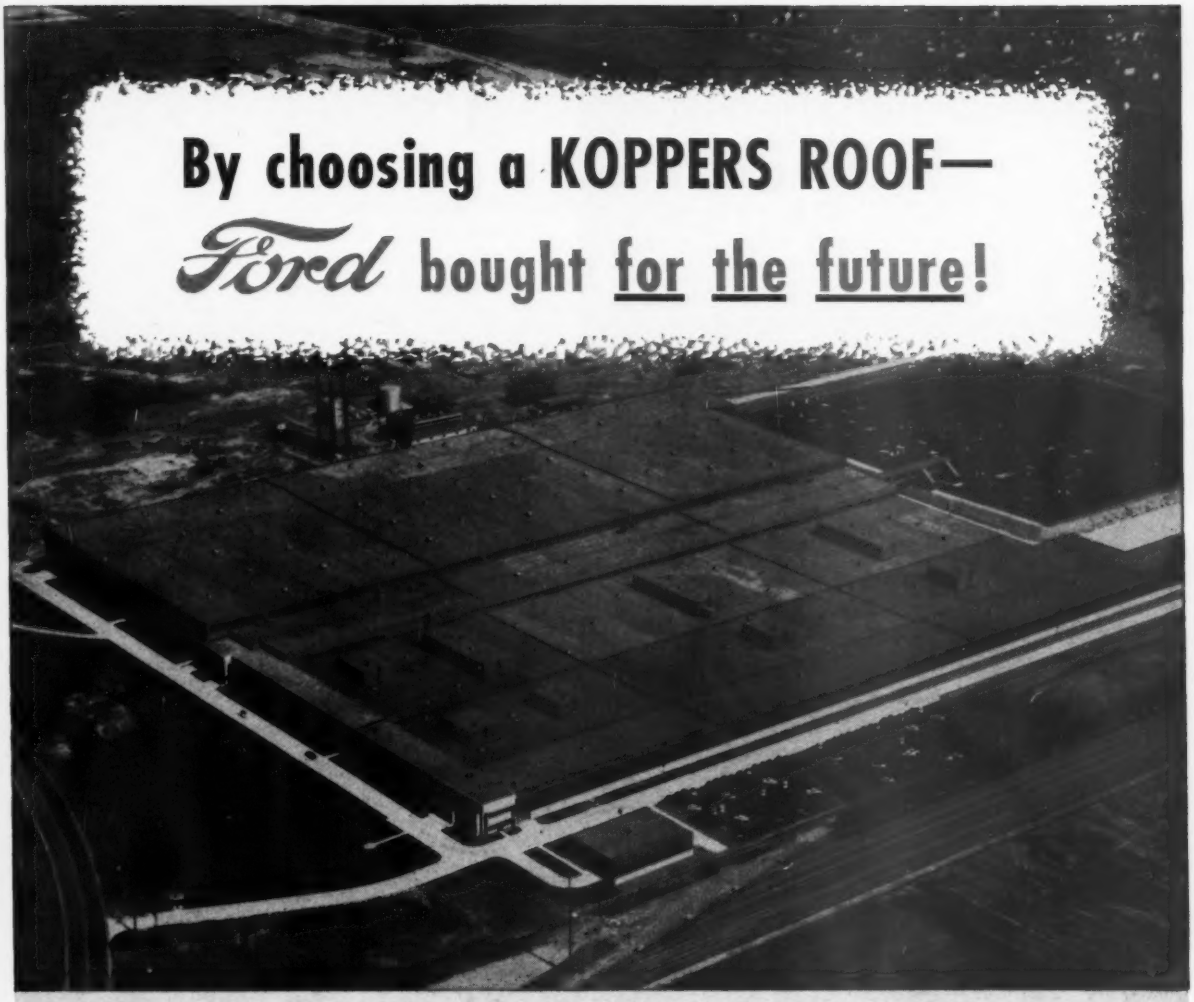

Ford's new plant, at Hamburg, New York, is protected by a Koppers Built-Up Roof. The roof is over a million square feet in area, and is bonded for 20 years.

Architect: Albert Kahn Associates, Detroit, Mich.
General Contractor: Bryant & Ditwiler Co., Detroit, Mich.
Roofing Contractor: Arrow Sheet Metal Works, Inc., Buffalo, N. Y.

"BUY FOR THE FUTURE"—that's what the Ford Motor Company tells its customers. And Ford followed its own sound advice . . . bought a Koppers Roof for its new stamping plant at Hamburg, New York. Koppers has *guaranteed* the performance of the roofing materials in this huge roof for 20 years.

Koppers Roofs are famous for the way they last. And it's not surprising! For these roofs are built-up with layers of Koppers Approved Tarred Felt, cemented together with Koppers Old Style coal tar pitch, to form a continuous skin over the entire roof deck.

The felt imparts elasticity and tensile strength to the roof membrane. The pitch provides the element that enables Koppers Roofs to resist prolonged contact with water *without deteriorating,* and makes Koppers Roofs self-sealing if small breaks occur. Together, Koppers Old Style Pitch and Approved Tarred Felt make an unbeatable roofing combination.

Koppers Roofing Materials are available from coast-to-coast. Specify these materials, and your projects will have the best in built-up roofing. For full information and specifications, get in touch with us.

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Drawing, Stretching, Stamping	22 min.
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Resistance Welding	12 min.
Arc Welding	10 min.
Torch Welding	17 min.
Tube & Shape Bending	13 min.
Brazing	7 min.
Riveting	26 min.
Sheet Metal Practice	20 min.
Machining	32 min.

(All films are 16mm, with sound. All are black and white.)

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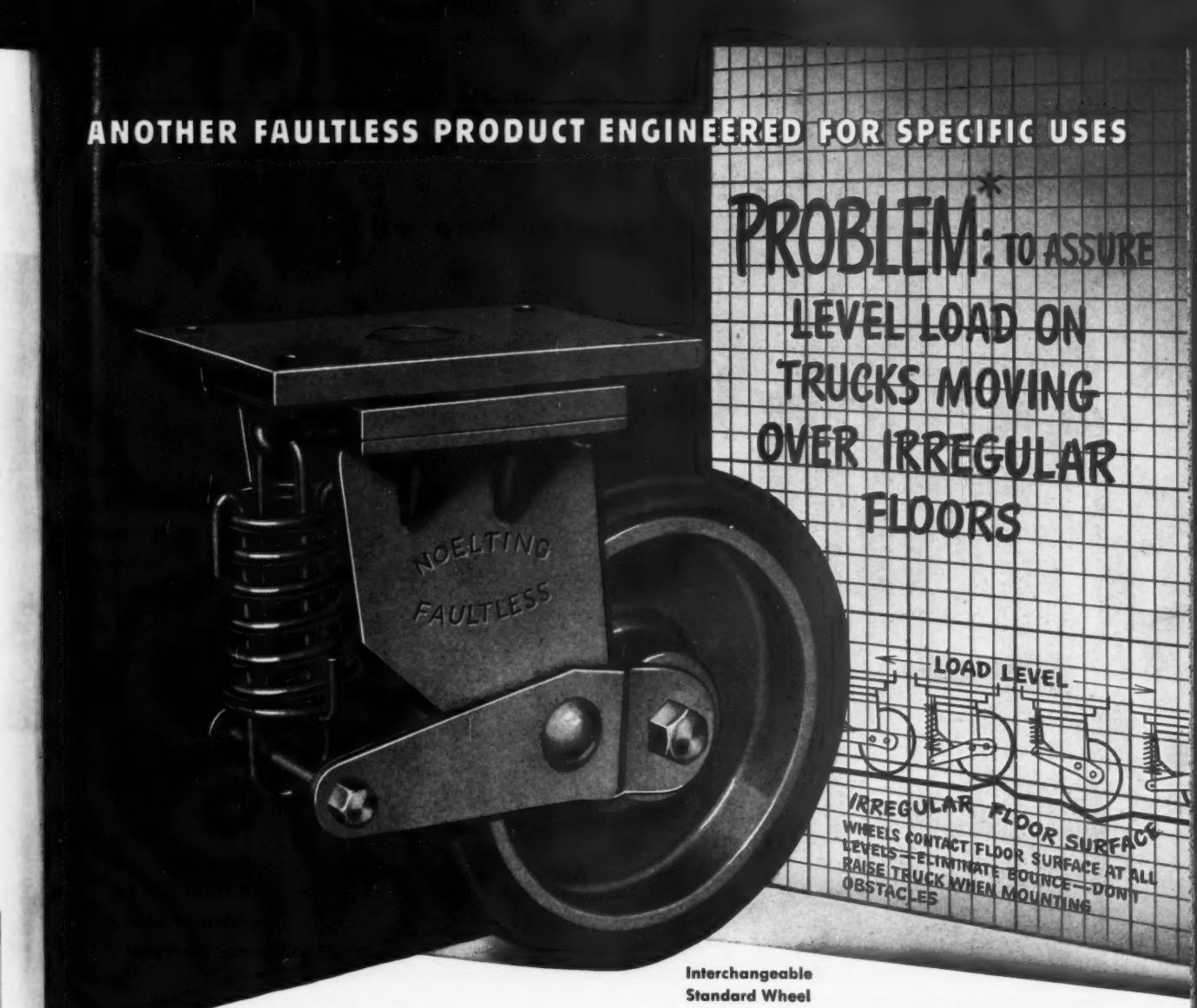
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WHEELS CONTACT FLOOR SURFACE AT ALL LEVELS—ELIMINATE BOUNCE—DON'T RAISE TRUCK WHEN MOUNTING OBSTACLES

The *answer to this materials handling problem is found in the New FAULTLESS S•H Double Action Spring Caster. Already time-tested by leading industrial engineers, this Caster is acclaimed for its use of standard, interchangeable wheels . . . absorption of high impact shocks through use of a large, durable spring *under constant tension* . . . spring and draw bar assembly a separate member. Here are *exclusive* features long sought by handlers of delicate equipment or finely adjusted products. Another way to cut your handling costs and man-hours. Write for descriptive literature, just off the press.

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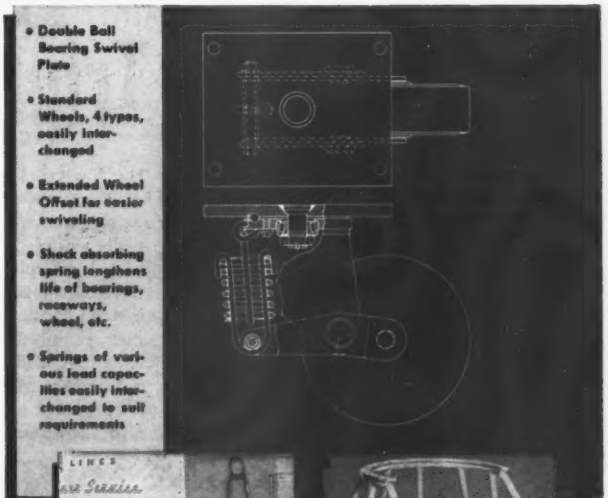


S-H Casters take jolts out of water tanks for leading Air Line.

S-H Casters cushion mechanisms of jet engines moved over rough floors.

FAULTLESS CASTER CORPORATION EVANSVILLE 7, IND.

Pacific coast office and warehouse: 1252 So. Boyle Ave., Los Angeles 23, California. — Stocks carried for immediate delivery.

Under the provisions of the revised building code of the City of Los Angeles, lightweight steel construction and hollow steel floor panels were used to advantage in the new Tishman office buildings. Bethlehem Pacific fabricated and erected the steelwork.

12-Story Triplets for Tishman

These three modern office buildings are being erected on Los Angeles' celebrated Wilshire Boulevard for Tishman Realty and Construction Company of New York. The buildings are identical, limit-height structures. They will provide some 600,000 sq ft of office space in a highly desirable location just west of the Ambassador Hotel.

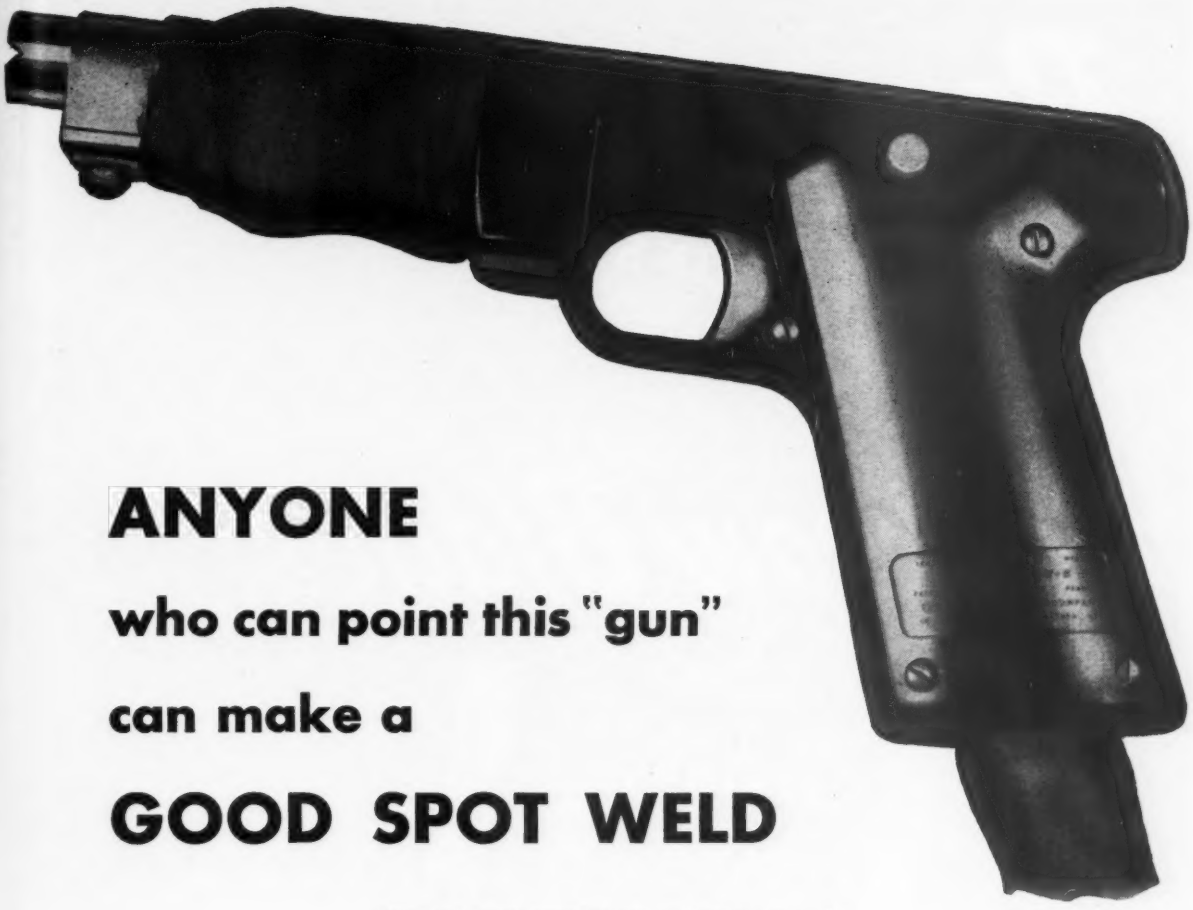
The structural steel frames of these buildings are unusually light, weighing only 11 lbs per sq ft of floor area. Under the modern building code of the City of Los Angeles, cellular light-gage steel floor panels were used as diaphragms to resist seismic forces. Suspended ceilings and vermiculite plaster were used to envelop the steel beams for fireproofing instead of the massive concrete encasement required by earlier building codes. This materially reduced the dead load, cut construction costs, and saved erection time. A reinforced-concrete central utility core extending up through each building provides all services, including elevators and air-conditioning. Windows occupy three-quarters of the exterior wall surface of each building.

Bethlehem Pacific fabricated and erected the steelwork for the three Tishman office buildings. The architect is Claud Beelman; Herman Spackler is associate architect; engineers are Brandow and Johnson; general contractor is C. L. Peck—all of Los Angeles.

BETHLEHEM PACIFIC COAST STEEL CORPORATION
General Offices: San Francisco

BETHLEHEM STEEL

BETHLEHEM PACIFIC



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who can point this "gun"

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GOOD SPOT WELD

"HELIARC" HW-8 Pistol-Grip Torch needs no forging pressure...works from one side of sheet...spot welds both STAINLESS and CARBON STEELS

Are you using light gage metals to fabricate large assemblies or irregular shapes? If so, chances are you can simplify many of your joining problems, boost production, and cut costs, too, by spot welding with the HELIARC HW-8 Torch.

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Connected to a suitable power source with auxiliary timer, the HELIARC Spot Welding Torch makes inert gas shielded welds without fumes, smoke, or spatter. Since operation is automatically controlled, workmen on the assembly line need only press the "muzzle" of the "gun" against the work and pull the trigger. A single hose assembly permits free use of the torch over a 25-ft. radius.

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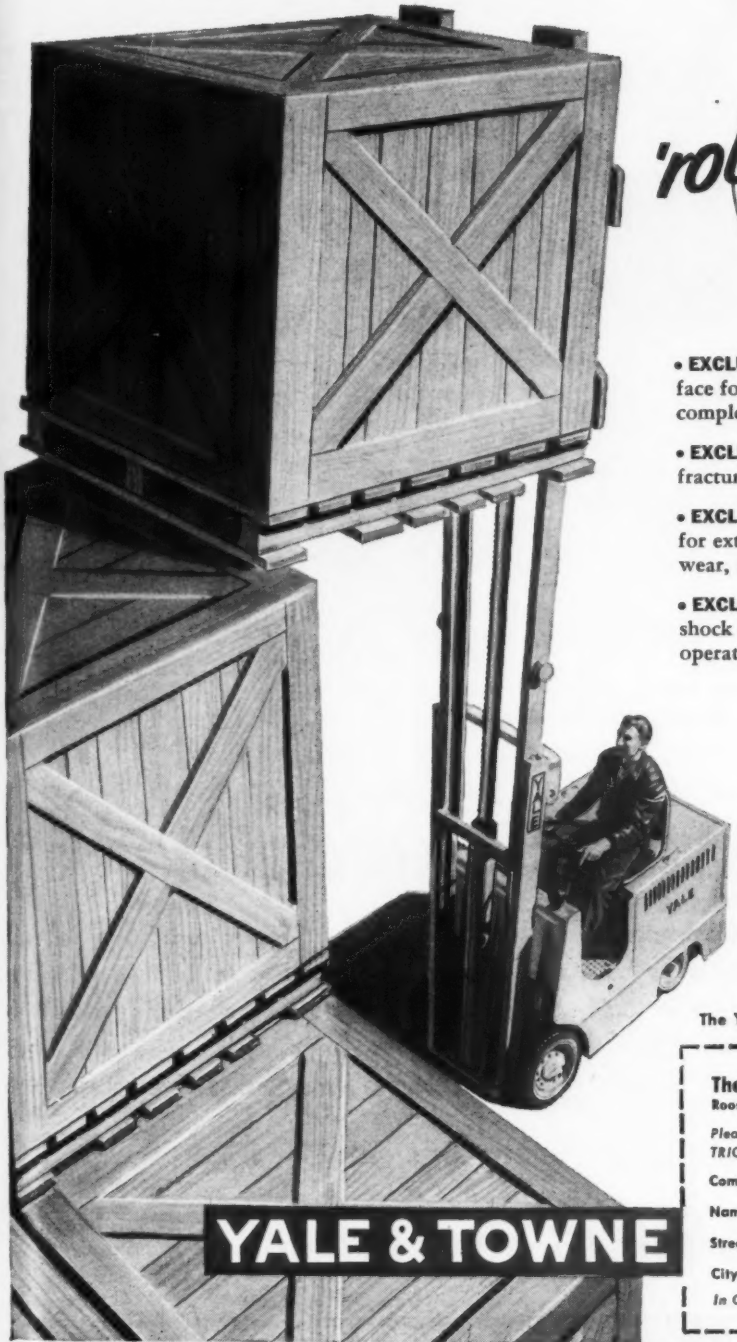

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Freeways . . . overpasses . . . bridges . . . it takes a lot of steel to build vital highways. In the past two years, steel has helped build 7,000 miles of highways in the West—enough to cross the nation twice!

It takes lots of steel to keep your car rolling!

West's roads take thousands of tons of steel a year

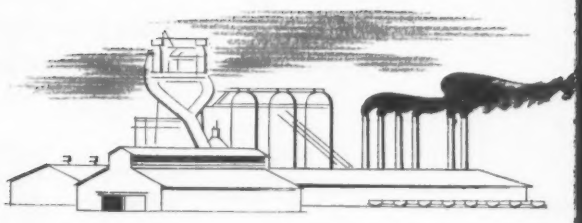
You don't usually think of highways needing steel. Yet the fact is that thousands of tons of steel have gone into 7,000 miles of western highways in the past two years. Steel for reinforcing concrete, steel for building overpasses and bridges, steel for the construction equipment needed to do the job. Yes, steel plays a big part in western highways. And a large part of this steel comes from Columbia-Geneva Steel, western producing member of U. S. Steel—the industrial family that serves the nation.

West's largest source of steel

Columbia-Geneva Steel Division

United States Steel Company

UNITED STATES STEEL



They did

The way this steel mill operator* licked his production problem spells out an answer for every executive who is trying to produce more. His problem was acute because he needed more production from the basic physical facilities he already had. Yet he could ill afford lengthy shutdown time.

what

So he asked Westinghouse engineers for help on a complete tandem mill drive . . . not just a quotation on devices. His staff and ours worked out an application of many devices—motors, controls, motor generators—to let him produce more with what he had. Result: production of this tandem mill was doubled, and the complete change-over made in 66 hours!

you can do

This case history carries a clear meaning for every industry, every manufacturing process. It says you solve capacity problems by applying capacity thinking. We want to do this kind of thinking with you and your engineer.

to produce more

You can choose the actual devices later. It's how you put them together that counts—whether meters, relays, generators, switchgear or welders. Many manufacturers make good electrical devices. Westinghouse, in fact, makes a broader line than anyone else. But the priceless ingredient Westinghouse offers you, in addition, is the skill of broadly experienced engineers in putting together the right combination of good devices to let you produce more with what you have. Westinghouse Electric Corporation, Pittsburgh, Pennsylvania.

*name on request

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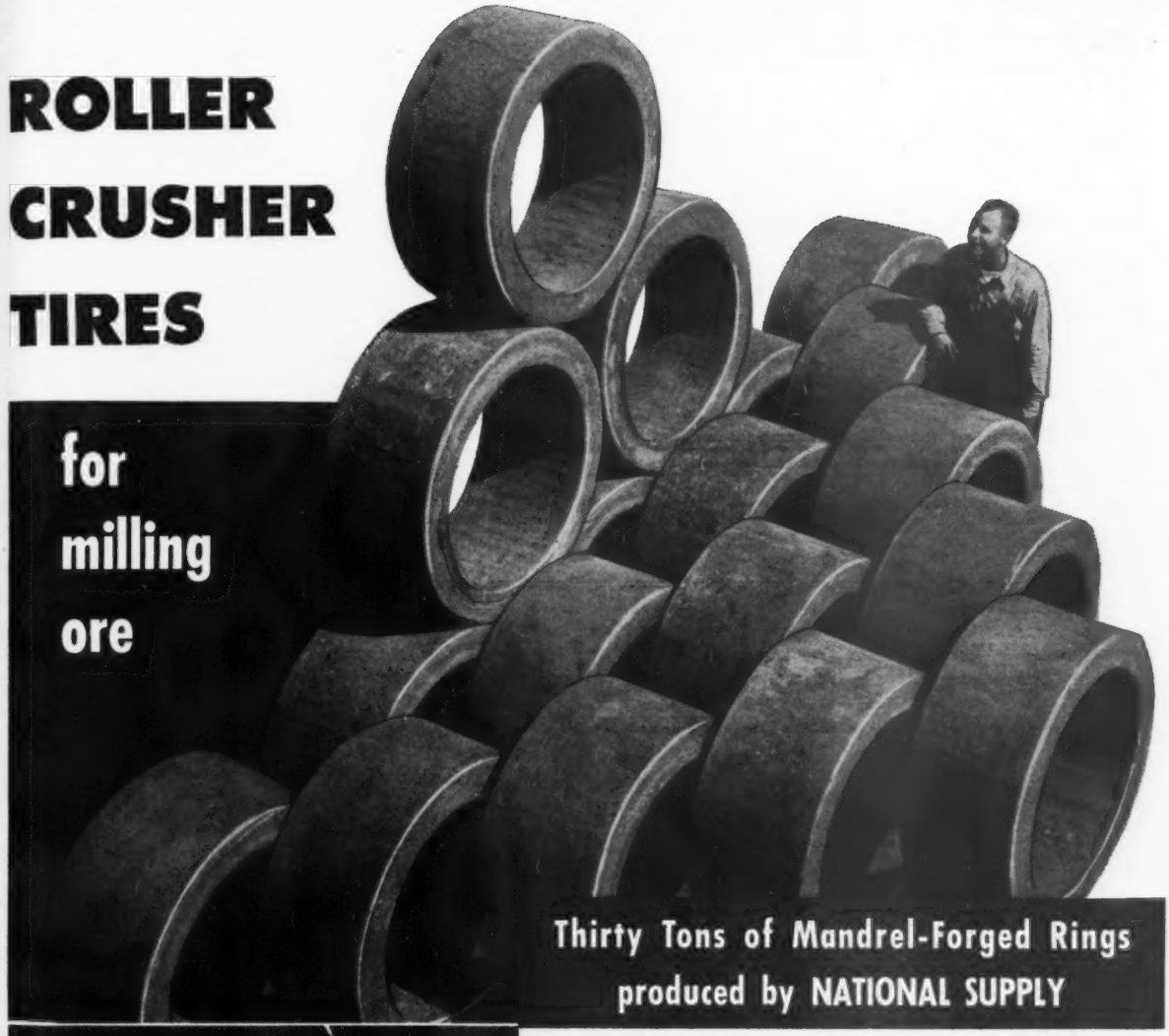
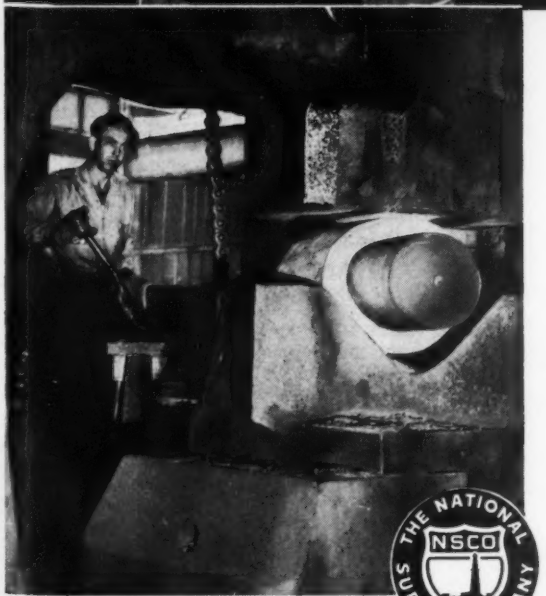
An independently owned and operated company serving Western industry

ROLLER CRUSHER TIRES

for milling ore



Thirty Tons of Mandrel-Forged Rings produced by NATIONAL SUPPLY



5,000# Hammer—one of the many types of forging equipment at Industrial Products Division.

The mining industry is just one of those served by the Industrial Products Division. And heavy forging is just one of the manufacturing operations performed at the Torrance Plant although the forge shop is capable of working ingots weighing up to 55,000 pounds.

Other specialized services rendered by the Industrial Products Division include casting, heat-treating, machining, welding, assembling—precision work on a production-line basis.

In addition, the Industrial Products Division is an experienced and accredited manufacturer of ordnance materiel. You'll find it worthwhile to send your tough jobs to Torrance, where the most complete facilities serve the most exacting needs of western industry.

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THE NATIONAL SUPPLY COMPANY

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ASSEMBLING • WELDING • TESTING

EDITORIAL COMMENT

The Youth Are the Hope of the Race

NAM is to be congratulated on taking its program in support of education, first announced back in 1948, so seriously. The program could either be lip service, an attempt at "thought control," or an honest effort to get our educational system on a stronger financial basis. Fortunately it seems to be the last of these three.

It has called upon all its members to continue efforts to obtain adequate public and private support for schools. It has suggested grants-in-aid, endowments, buildings, scholarships, research projects and contributions to organize which raise and disburse funds for specialized education.

Some of industry's most able leaders, says the NAM, have concluded that the only alternative to further federal aid to education, with its grave implications to academic freedom, lie in calling on business and industry to help provide the necessary funds. Some of them have proposed that business enterprises set aside a fixed percentage of their earned income for the support of education and philanthropic endeavors, which might conceivably total a billion dollars a year, or one-fifth the present nationwide expenditure on public schools.

In the West, NAM has appointed the man who straightened out a badly aggravated public controversy in Pasadena over the school system to head up its education department. Dr. Claude W. Fawcett will have the eleven Western States as his territory. On the NAM educational advisory committee are H. C. McClellan of Old Colony Paint & Chemical Company, Los Angeles, and Kinsey M. Robinson of The Washington Water Power Co., Spokane. Five members out of the 25 composing its educational advisory committee are from the West. They are: Eugene B. Chaffee, president of Boise Junior College; Dean J. Hugh Jackson of Stanford's graduate school of business; Dean Edwin A. Lee of the UCLA school of education; Kenneth E. Oberholtzer, superintendent of Denver's schools, and President Lynn White, Jr., of Mills College, Oakland, Calif.

America First

IF LABOR TROUBLES start to develop which may interfere with defense production, they would soon subside if leaders on both sides of the management-labor fence were immediately hustled off to Korea to get a close-up view of the conditions under which our men are fighting, in the opinion of Captain George M. Keller, who played an important part in the Navy's industrial relations program in World War II.

Captain Keller, now connected with the Committee for a Free Asia, Inc., in San Francisco, has some experience along that line to back up what he says. In 1945 a team of labor leaders from the Pacific Coast, embracing many shades of opinion, visited the war zones in the Pacific under government auspices, with salutary effect. When they came home they were of one mind: the war must be won as fast as possible, and nothing should be allowed to interfere with the effort. They also put their views into practice.

IN OUR MAILBOX

Machine Shop Estimating

Editor, *Western Industry:*

Your November issue contained many interesting articles, but the one by W. A. Nordhoff (Machine Shop Estimating) was particularly interesting to me. I have worked for the Continental Can Co. for 23 years, the last seven years as a process engineer in the industrial engineering departmnt.

W. KALLGREN
Spokane, Wash.

(Mr. Nordhoff, chief machine shop estimator, Douglas Aircraft Company, is the author of the article referred to above, which appeared in two installments, in the November and December issues.)

* * *

Let's Enlighten Everybody

Editor, *Western Industry:*

I have just finished reading your 4th Annual Review and Forecast, January 1952. I have found it most interesting and enlightening.

You may be interested in our INDUSTRIAL CENTER area here. We purchased the former Remington Arms plant from the Government in June, 1948. There were approximately 1½ million sq. ft. of floor space and 3,000 acres of land. In the some three and a half years we have had this plant, we have occupied all of our building space and had three new plants built at a cost of about five million dollars. It has been interesting to us to see the phenomenal growth of this area. We, at present, have some 36 different concerns doing business here with something over 3,000 employees. Salt Lake City has absorbed this amount of space very easily and continues to grow. The plants that are in our area have embodied in their operations the most modern and up-to-date methods that could be obtained.

L. S. SWANER, Manager and
Co-owner, Industrial Center,
Salt Lake City, Utah.

(Another report on Western development. Incidentally, in our February issue can be found a description of the materials handling set-up at the ZCMI wholesale warehouse, located in the industrial center mentioned above.)

* * *

Yanks Are Coming

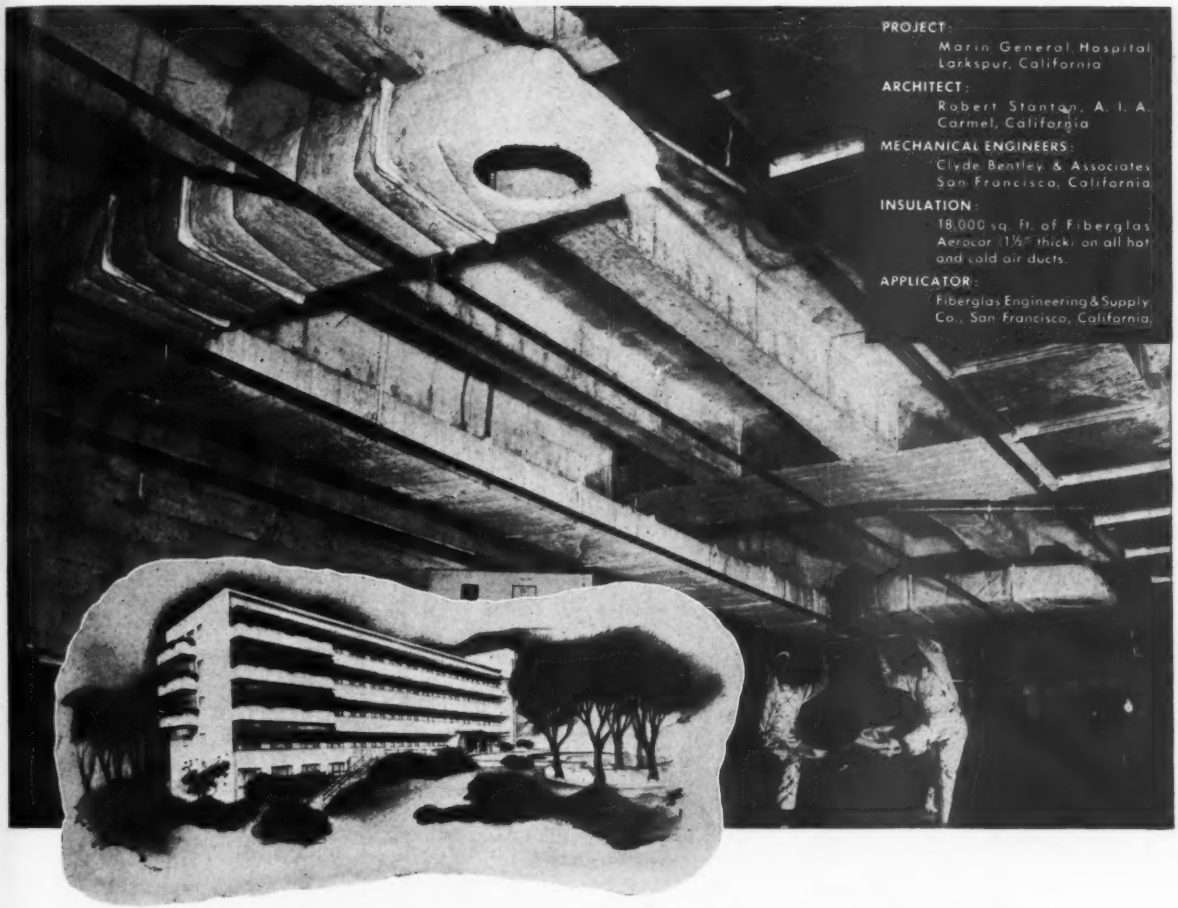
Editor, *Western Industry:*

I note in your September 1951 issue of *Western Industry,* on page 81, an item concerning manganese.

Would you kindly provide the writer with the address of The Southwestern Engineering Company, as we are greatly interested in this new development.

W. BARTLETT CRAM
Industrial Agent
Maine Development
Commission
Augusta, Maine.

(Another proof that all eyes are on the West.)



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Here's another important duct job where the lightness, flexibility and efficiency of Fiberglas Aerocor* lowered the cost of installation and air system operation.

This versatile duct-insulating blanket weighs less than 1 ounce per sq. ft., 1" thick . . . is readily adapted to irregular and hard-to-reach surfaces. With a "k" as low as .23 at 75° F., Aerocor tops all other insulations in efficiency. Can be quickly and easily cut to shape with an ordinary knife.

Whatever your duct insulation problem, there's a Fiberglas material engineered to solve it economically. For example, Fiberglas Coated Duct Insulation may be applied on the outside or inside of rectangular ducts . . . deadens noise, is easily painted, does not erode. Fiberglas Vapor-Seal Insulation controls condensation on cool-air ducts in warm, humid areas. And Fiberglas PF (Preformed) Insulation is a favorite for many types of duct jobs. Fiberglas Duct Insulation will not burn, rot or settle under vibration.

Phone the nearest Fiberglas office for name of your local applicator and a copy of "Fiberglas Industrial Insulations." Or write to OWENS-CORNING FIBERGLAS CORPORATION, Dept. 113-C, Box 89, Santa Clara, Calif.

PACIFIC COAST DIVISION SALES OFFICES: Albuquerque, Denver, El Paso, Eugene, Fresno, Los Angeles, Phoenix, Portland, Sacramento, Salt Lake City, San Diego, San Francisco, San Jose, Seattle.

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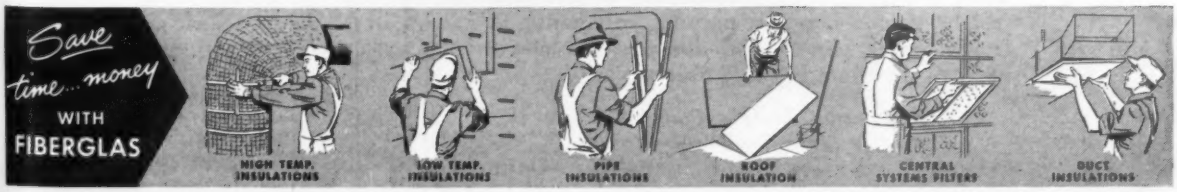

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E. B. Johnson, Freight Traffic Manager
Santa Fe Lines, San Francisco, Calif.

CALENDAR OF MEETINGS

March 27-28—Tentative date for Fourth Pacific Northwest Industrial Waste Conference, at Washington State College, Pullman, Wash. Subject: Industrial Wastes, their control, utilization and disposal. Sections: Food Industries, Wood Industries, Mineral Industries, Chemical Processes. Contact E. B. Parker, Washington State Institute of Technology, Division of Industrial Services, State College of Washington, Pullman, Wash.

March 31, Apr. 1-3—California Industrial Education Assn., in Oakland, Calif. Contact Lee Bodkin, Sec.-Treas., 131 Education Bldg., University of California at Los Angeles, Los Angeles, Calif.

March 31-April 2 — Intermountain Logging Conference, in Spokane. Contact Charles P. Keim, Buffalo Bldg., Kalispell, Montana.

April 1952—Pacific Northwest Purchasing Agents Conference, in Seattle. Contact E. O. Haymond, Shell Oil Company, Portland, Oregon.

April 1-2—Seventh annual meeting of Northwest Wood Products Clinic, at Davenport Hotel, Spokane, Wash. Contact R. O. Batdorf, P. O. Box 684, Spokane, Wash.

April 4-5—Annual meeting of Western Highway Institute, 11 Western States research and coordination agency for the motor carriers, at Palm Springs. Contact Western Highway Institute, 417 Market St., San Francisco.

April 4-5—California Industrial Education Association conference, in Oakland, California. Contact Mrs. Eleanor Hewlett, Laney Trade School, 240 E. 10th St., Oakland, Calif.

April 7-9 — National Agricultural Chemical Assn., at Fairmont Hotel, San Francisco. Contact Lee S. Hitchner, Exec. Secretary, 917 17th St., N.W., Washington, D. C.

April 15-16—27th Pacific Coast Management Conference, at Claremont Hotel, Berkeley, Calif. Contact Everett Van Every, secretary-manager, California Personnel Management Assn., Farm Credit Bldg., Berkeley 4, Calif.

April 22-26—Pacific Northwest Water Works Association convention, at Davenport Hotel, Spokane, Wash. Contact Elmo Jones, MA 4341.

April 25—National Tank Truck Carriers Conference at Hotel Del Coronado, Coronado, Calif. Contact C. A. Sutherland, 1424 16th St., N.W., Washington, D. C.

April 28—Northwest Public Power Assn. exhibit at Olympia Hotel, Seattle. Contact Gus Norwood, 1311 Columbia St., Vancouver, Wash.

More CALENDAR on page 30

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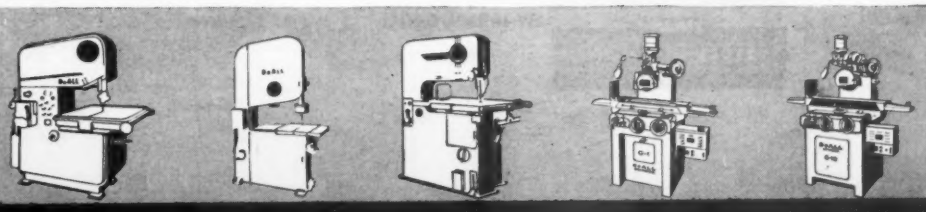

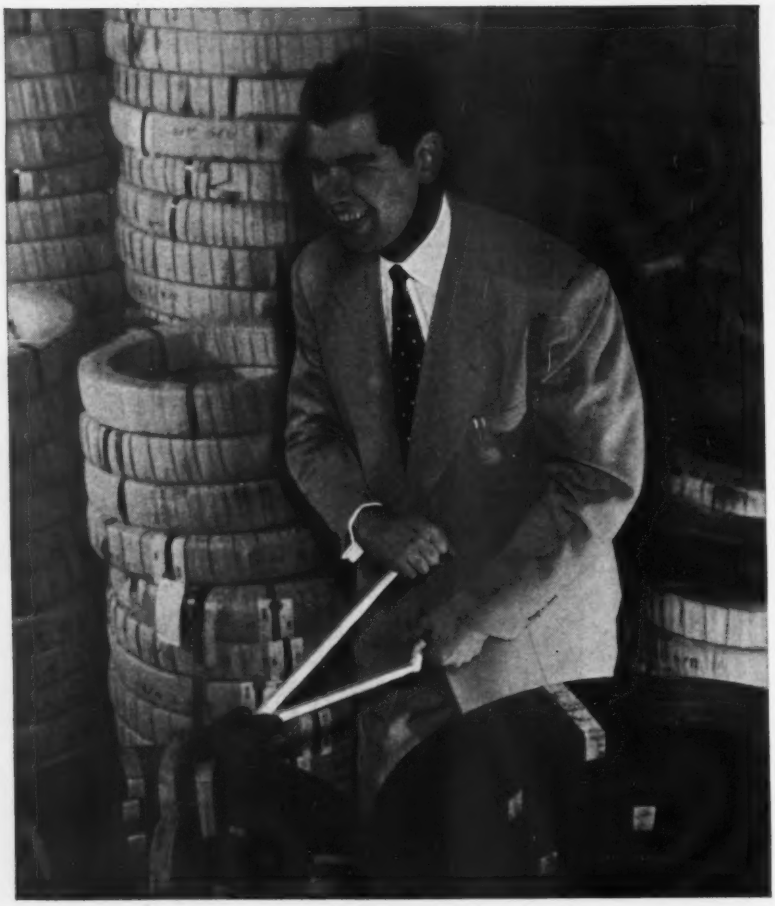

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CALENDAR OF MEETINGS

Begins on page 28

April 30-May 2 — American Public Power Assn. Conference, in Seattle, Wash. Contact Alex Radin, 1757 K St., N.W., Washington, D. C.

May 2-3—Annual meeting of Western Dry Kiln Clubs, at Redding, Calif.

May 5-6—Second National Air Pollution Symposium, at the Huntington Hotel, Pasadena, Calif. Sponsored by Stanford Research Institute in cooperation with California Institute of Technology, University of California, Los Angeles, University of Southern California. Contact A. M. Zarem, Chairman, Rm. 332, 612 South Flower St., Los Angeles, Calif.

May 8-9—U. S. Independent Telephone Association, Executive Conference, in Colorado Springs, Colo. Contact Stewart A. Collins, Secretary, 411-17 Munsey Bldg., Washington 4, D. C.

May 9-10—American Institute of Mining & Metallurgical Engineers conference, at Davenport Hotel, Spokane, Wash. Contact Roger Oscarson, RI 6171.

May 12-15—American Petroleum Institute Division of Refining convention at San Francisco. Contact Lacey Walker, Secretary, 50 West 50th St., New York 20, N. Y.

May 14—Manufacturers Conference, Alameda County Manufacturers Division, Oakland Chamber of Commerce, at Hotel Claremont, Berkeley. Contact Ken Moeller, Oakland Chamber of Commerce, 427 13th St., Oakland, Calif.

May 15-17—California Society of Professional Engineers Convention, in Los Angeles. Contact A. C. Bullen, 1070 Los Flores Drive, Del Rosa, Calif.

May 18-22—International Conference and Annual Office Machine Equipment Exposition, at Fairmont Hotel, San Francisco. Contact A. C. Spangler, 132 W. Chelten St., Philadelphia 44, Pa.

May 19-20—Northwest Public Power Association conference at Spokane Hotel, Spokane, Wash. Contact Gus Norwood, Executive Secretary, Engineering and Operation Section, Audressey and Macauthier Blvd., Vancouver, Wash.

May 20-23—Office Equipment Manufacturers Institute, at San Francisco. Contact E. D. Taylor, Ad. V. Pres., 1903 N. St., N.W., Washington, D. C.

May 21-23—Gas Appliance Manufacturers Assn., annual meeting, at Broadmoor Hotel, Colorado Springs, Colo. Contact H. L. Whitelow, Association headquarters, 60 E. 42nd St., New York City, N. Y.

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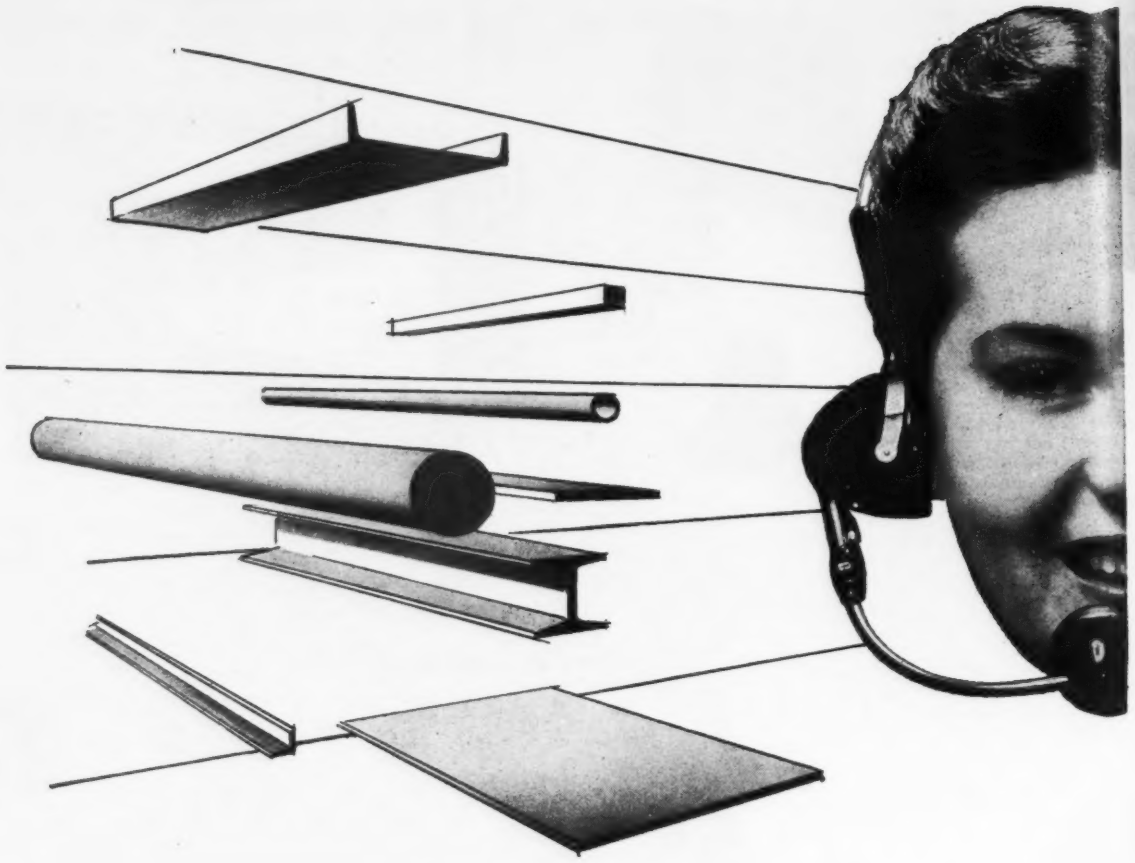

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METALS AND METALWORKING NUMBER

• what's in it for YOU? •

WHEN you are awarded a contract of new business, amounting to perhaps $50,000 or $100,000, how much money can you afford to channel into manufacturing development? How much time can you afford to develop new manufacturing techniques? How many men can you afford to put on this sort of work? Probably none.

On the other hand, when a primary aircraft manufacturer is awarded a defense order amounting to perhaps $100,000,000, he can afford to allocate say, 1% of that amount (that's $100,000) toward developing his manufacturing processes and techniques. He is also in good position to delegate a number of skilled men to work out such a program. End result will be a superior aircraft, produced at less time and expense.

From the founts . . .

Naturally then, out of this present defense program—which will probably gain full strength this year—there will be born a number of significant developments within the portals of the primary aircraft producers. They are now the focal point in today's metalworking industry.

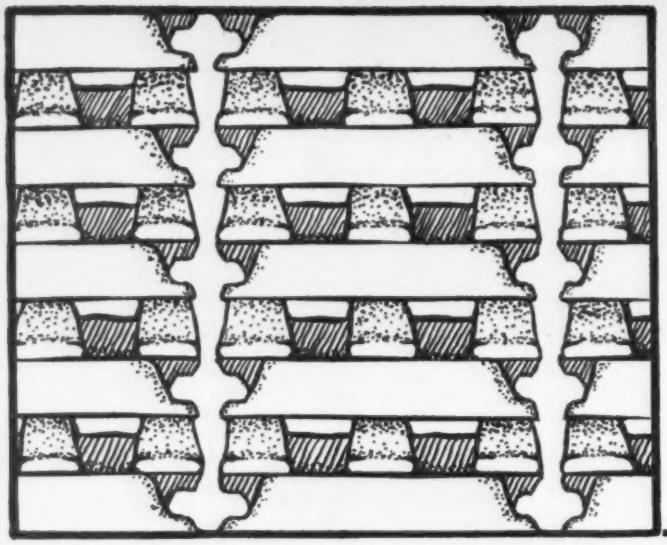
These new techniques, processes, ideas, will eventually be in common use by all the shops doing the same kind of work.

Sooner or later, the smaller shops would get the "latest dope" on these improvements, but such a process usually takes a long time. These are not normal times, and rather than let "nature take its course" *Western Industry* has traveled to the founts of information in order to get this data first hand and authoritatively, to pass on to you for your use and benefit.

. . . information for your profit

For this specific purpose, *Western Industry's* managing editor took an extensive trip, visited every one of the major aircraft producers and many of the major subcontractors in California. Numerous conferences were held with responsible operating executives in these plants. Our specific mission was to gather down-to-earth information that would benefit you . . . information that you can read, understand, and put to immediate profitable use.

Special issues of *Western Industry* are published with but one main purpose: to meet your particular needs for information that will help you solve your problems immediately ahead. Most of this, our Annual Metals and Metalworking Number, is composed of just such articles, gathered within the past few weeks. This information is timely, it is factual, and it is authoritative.



METALS & Metallurgy

Why subcontractors must

LEARN ABOUT NEW METALS

AERONAUTICAL ENGINEERS have always dreamed of greater speed with greater payload. Urgent current military requirements have brought advances in aerodynamics, structural design and engineering materials which have made possible speeds and payloads undreamed of ten years ago.

Development of jet propulsion alone has done much to change the concepts of aircraft design. Today's aircraft are designed to travel at speeds at least double those attainable by 1940's aircraft. Extremes in aerodynamic design are necessary to meet requirements of trans- and supersonic flight.

New Designs Need New Metals

Design requirements imposed upon aircraft by the jet engine have introduced new thinking in aircraft materials. Materials engineers are compelled to extend material performance to previously uncontemplated degrees, to keep pace with advances in propulsion and aerodynamics. Each increase in speed or weight has brought attendant increases in heat and strength requirements.

Materials are the limiting factor today in designing aircraft to perform at greater speeds and to carry greater weights. As unbelievable as the feats of the metallurgist have been in developing heat-resistant materials of greater and greater strength, he is still a bottleneck in the broad picture of air travel.

Over-all efficiency of aircraft engines increases with maximum operating temperatures. Fuels have been developed that will produce temperatures higher than 4,000 deg. F. To date no metal has been developed which will contain combustion at that temperature over an extended period of time.

By

CURT W. BOHMAN
Methods Engineer

and

ALAN V. LEVY
Metallurgist
Marquardt Aircraft Co.
Van Nuys, Calif.

For example, the gaseous combustion products which provide thrust as they leave the exit nozzle of a jet engine must be cooled to the operating temperatures of the metals used in the construction of the engine.

Loss of efficiency coincident with the need for cooling the gases is, in essence, how the materials used in jet engines are a limiting factor in their development.

Problems in the "Hot Spots"

Metals in use today have pushed material operating temperatures up to 1,600-1,800 deg. F. Engine designs which utilize chamber wall cooling have been able to contain combustion where gas temperatures reach 3,500 deg. F.

Materials such as Inconel-X, 19-9DL, 310 Stainless Steel, and the Nimonics are in fairly common use today at the "hot spots" in jet engines. Even such non-metallic substances as graphite and ceramics are used because of their high-temperature properties.

As engine operating temperatures increase, the airframe manufacturer is confronted with the problem of protecting components surrounding the engine from temperatures considerably above the 350 deg. F. maximum operating temperature of aluminum. Stainless steel is fulfilling the need of high temperature strength at a considerable

sacrifice in weight; tomorrow, titanium alloys may replace most of the stainless steel used by the airframe manufacturer. Titanium has the elevated temperature strength of stainless steels with only 60% of its weight. Maximum operating temperature of titanium and its alloys is about 900 deg. F. Its limitations as an engine alloy are obvious, but its use in surrounding components can be a godsend to airframe designers and builders.

Such factors as super-thin wings, internal engine mounting, tremendously increased weight and increased air-resistance due to higher speeds, all contribute to the necessity for greater strength of materials. Steel alloys which have tensile strengths of 180,000 psi. are being replaced with alloys that can be heat-treated to strengths

Supersonic flight attains too much Fahrenheit for planes

of 240,000 psi. with reasonable ductility remaining for vibration and impact loading.

New names such as Hy-tuf, B-514, 17-7PH, and others are typical of metals now specified in material blocks on drawings of landing gear and other high-strength components. These alloys are gradually replacing SAE 4140 and 4030 used in World War II.

Speeds approaching or exceeding that of sound present distinct problems of heat generated by friction of air rapidly passing over sheet metal surfaces. Surface temperatures of 300-400 deg. F. are ever present problems in guided missiles. Skin temperatures up to 500-600 deg. F. are distinct possibilities. Aluminum is very weak at these latter temperatures. Titanium and its alloys seem to be an answer to this problem. New magnesium alloys are also being seriously considered.

Along with temperature problems due to high speeds, the mechanical continuity of aircraft exterior surfaces has become increasingly critical. Machined skin edges, exact fits at skin joint, flush-milled riveting and scratch-free surfaces are musts today.

As skin temperatures increase, the ambient air temperature of the whole machine increases. Therefore, it would seem that eventually all parts of the aircraft must be manufactured of high-temperature alloys. New high-temperature aluminum and magnesium alloys are being developed to fill this need.

As is usually the case where added performance is gained, the advances are made at the expense of some other characteristics of the system. The metals which boosted possible operating temperatures and strength levels also boosted fabrication difficulties many fold.

That property of the new high-temperature alloys which is responsible for the increased problems of the manufacturer is work hardening. As the material is formed, its resistance to further deformation increases at a rate much greater than that experienced in alloys in common use ten years ago. Metals which were developed to attain greater strength levels in resisting deformation in service also tend to resist deformation in fabrication.

The Challenge to Fabricators

What does modern metal technology mean to the fabricator of aircraft parts and especially to the subcontractor who has recently re-entered the aircraft business? Are the equipment and personnel used to turn out thousands of World War II parts sufficient to handle today's "super" materials properly?

Today's equipment requirements are such that the machine facilities built up during World War II are largely out-moded in horsepower, rigidity, speed and feed selection, attainable tolerances and possible operational methods. Machine finishes beyond the ability of the garage lathe are standard requirements on most aircraft parts.

In the '40s, horsepower of one-fifth of today's needs were ample to do the ordinary run of subcontracting work. A five-horsepower milling machine was considered fairly heavy equipment only a few years ago. Today 25 to 50 hp. are needed to produce parts on a quantity basis. Lathes in the last War having two-hp. motors were common. The same job on new materials now requires 10 to 15 hp. and twice the time.

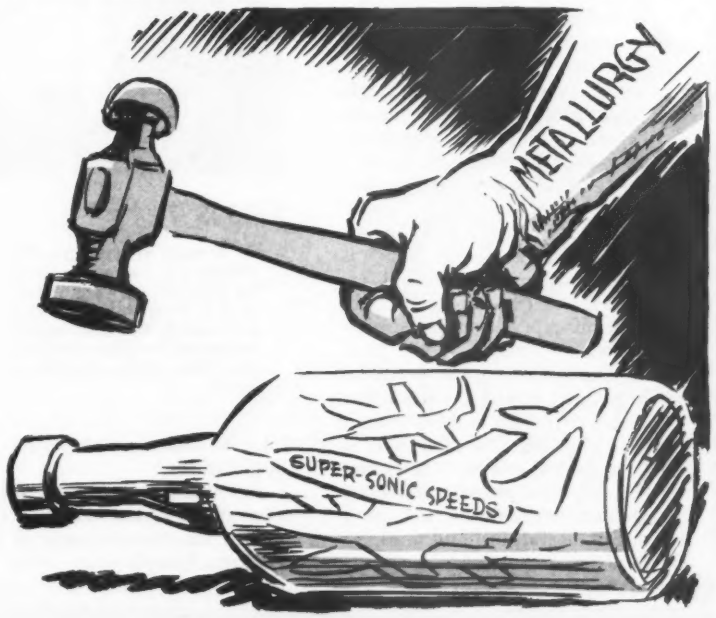
The Micro- and the Macro-

This trend holds true in practically all types of equipment used. As horsepower requirements increase, machine sizes must increase to provide the rigidity necessary to do an accurate job. Lockheed, for example, now has a group of machines that has acquired the nickname, "Hall of Giants."

Tolerance limits have shrunk to new lows. Tolerances of the order of .0001 in. or .0002 in. are fairly common in aircraft control equipment.

Sheet metal tolerances have been tightened up from plus or minus .03 in. during World War II to as close as plus or minus .005 in. for today's high speed aircraft. Increased accuracy re-

Metals today are still far away from future requirements of flight; Super-high speed stimulates need for newer alloys, tough and light



quirements involve additional complex testing and inspection facilities as well as more accurate measuring devices built into the machines themselves.

Entirely new methods of forming are coming into use, especially in sheet metal work. Stretch forming, hydraulic forming using rubber blocks under tremendous pressures, forming at elevated temperatures and other innovations are tools needed to manufacture parts of the new alloys. The work hardening characteristics of stainless steels and other high-temperature metals are particularly felt in sheet forming work. Minimum bend radii have increased.

Parts scrappage due to fracture in forming are a critical problem that has to be fought in processing each different part. The fabrication problems of titanium exceed those found in stainless steel. Hot forming at 700-800 deg. F. is a necessity for parts of any complexity.

Machining titanium requires heavy feeds at very slow speeds to prevent excessive work hardening and welding of the material to the tool. Titanium will present a series of unique problems to the fabricator. Those problems will have to be licked one by one. In tool fabrication the jig borer is now the rule rather than the exception. To produce tooling equipment efficiently, expenditures and numbers of pieces of equipment necessary to do an adequate job run from three to five times the amounts involved in the past.

Tougher materials have established the use of the grinder as a common finishing step on many machined surfaces. Hones are to today's hole size what the reamer used to be.

Personnel

The days of "Rosie the Riveter" are over. Today's materials and tolerances demand highly skilled personnel to transform rough stock into finished parts without excessive spoilage and wasted time. The large amout of time and effort invested in each part demands that each employee's output be a continual flow of high quality work.

These requirements become the responsibility of the individual worker, and attention to them cannot be relaxed at any time. The ability to produce parts to the close tolerances and fine finishes required in aircraft and guided missile work is not mastered over night. Training programs must be extensive to prepare old and new personnel alike to handle the complex machinery and sensitive materials in use today. The natural trends in new materials and designs to increase fabricating difficulties and costs of parts cannot have poor workmanship added to them. Efficiency of the highest degree must be attained from each employee and must be maintained in order to control costs which cannot help but be high under the best of conditions.

Few people realize the complexity of the jet plane that roars overhead. The ingenuity and efforts of many people have gone into making our aircraft the world's best. Today more than ever before, the role of the fabricator is primary in enabling man to travel faster than sound.

Where does TITANIUM *stand today?*

TITANIUM IS TODAY THE DARK HORSE in tomorrow's race for new metals. Much has appeared in the press about titanium, but of a general nature with few exceptions.

Actually, and regardless of the publicity roar about this new metal, it is still in the pilot stage. It will probably be many months before titanium can mean much —or even be used—by the majority of subcontractors, because of (1) the high price (up to $15.00 per pound), (2) the limited amount available (which is going primarily to research efforts), and (3) the lack of fabrication experience and specifications.

Titanium has great potential in aircraft manufacture, since it resists corrosion and is stronger than aluminum, is about half as light as steel and twice as strong. All the major aircraft producers are now in the throes of finding out its usefulness, and working to develop a record of experience on different phases of its applications.

THIS IS IT . . .

A chunk of sponge-like titanium is being examined by Geo. W. Llewellyn (left) of H. K. Ferguson Co., builders, and R. P. Smith (right), manager for Titanium Metals Corp. at the Henderson plant.

For example, it would appear that titanium should be fine for use in the manufacture of jet engines. Sample parts made of titanium are now being tried and tested in these units.

Primary aircraft manufacturers are also trying out samples of the metal, installed in planes in actual use. No pure titanium is being used—only alloys of the metal, of which there are countless possibilities.

Tests are being conducted for strength, workability, and to determine physical property characteristics — in sheet, rod, bar, and forgings of the alloys.

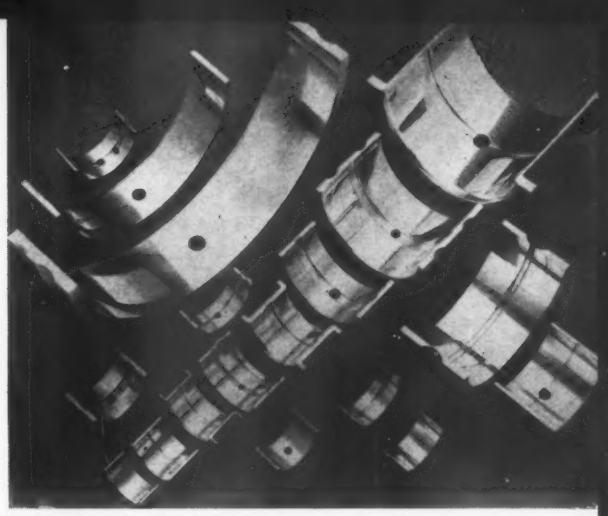
Certificates of necessity and guaranteed loans have been extended to some firms interested in producing the metal. Steel and chemical companies are working on the production phase, and three of this country's biggest non-ferrous metal producers, we understand, are expanding their capacity to produce titanium.

Last year saw production of around 500 tons of the metal; 1950 production was only 60 tons.

Before this year is ended, Titanium Metals Corporation of America, a subsidiary of National Lead Co. and Allegheny Ludlum Steel Corp., expects to be producing 3,600 tons annually in its Henderson, Nevada, plant.

ALUMINUM DEVELOPMENTS—

their contribution to metalworking



PERMANENT MOLD cast aluminum alloy automotive bearings. (Alcoa photo)

IN ADDITION to the increase in the smelting facilities by all three major aluminum producers, many important installations of new equipment for improving fabrication are under way. Alcoa's newly developed new direct reading quantometers is an example. The quantometer consists of a direct reading spectroscope for metallurgical analysis.

This great advancement in the field of electronics makes it possible to take a sample disc of aluminum, place it on the quantometer sparking stand and in less than a minute's elapsed time, an analysis report is speeding back to melting rooms or production line by teletype or pneumatic tube.

Immediate Analysis

This procedure replaces historical analysis methods which consumed a considerable amount of time and makes on-the-spot metallurgical quality control possible, which has never been known in the past.

Aluminum coiled tube was developed and marketed during 1951. Alcoa calls this "Utilitube," and the product is suitable for many purposes such as gasoline and oil lines for internal combustion engines, gas lines for stoves and heaters, and air vacuum lines in brakes, and instruments replacing scarce copper tubing.

Pressed structural channels for cross-member floor supports in truck trailers were deveoloped, thus enabling the manufacturer of trucks to have cross channels of varying depth to increase strength and reduce weight.

Commercial operating procedures were announced for applying alumilite hard coatings with exceptional resistance to wear and abrasion. These coatings are in a thickness of .001 in. to .002 in. and may be applied to both wrought and cast aluminum alloys. Articles with this new wear resistance alumilite finish are being evaluated for gun blast tubes, gears and impellers and similar applications where resistance to abrasion is required in combination with light weight.

Several immersion and electroplated coatings for aluminum pistons were developed in 1951 as a substitute for tin, in view of the scarcity of that metal. Some of these coatings appear even better than tin in their resistance to cold scuffing.

Highway Truck Tanks

Cooperation between Kaiser Aluminum and Chemical Corp. and Beall Pipe and Tank Corp., Portland, developed the first apparently successful aluminum truck tank, used primarily for roadway transportation of petroleum. This first model has a capacity of 8400 gallons and is constructed so that fatigue failures in the all aluminum frameless body appear to be eliminated. Circumferential welds were eliminated completely by use of 24-ft. skin sheets; heat effects at longitudinal welds were reduced through altered joint design.

Further progress in the development of aluminum alloy bearing sheet for use in steel-backed aluminum automotive bearings was made. Tests are currently being made of this type of bearing on various types of engines, and the results to date have been most favorable.

Alcoa developed a bonding process by which such items as inserts for ring grooves in heavy duty engine pistons were made possible. This application permits the operation of pistons at higher temperatures and pressures and prevents excessive ring groove wear in the top piston land under heavy duty conditions.

Anode rods having a steel core and relatively heavy coatings of aluminum were developed to protect containers and tubes of certain metals against internal corrosion.

During 1951 Alcoa developed a process using simple equipment for making welded joints in aluminum wire conductors for the purpose of providing a means of rapidly making terminal joints for aluminum coil windings in motors, transformers and solenoids without the use of fluxes and solders. This has become increasingly important with the growing shortage of copper for electrical equipment windings.

A new aluminum alloy was developed for aircraft use, which has temporarily been designated as XA78S. It is approximately 10% higher in tensile and yield strengths than Alcoa's rugged 75S alloy. So far Alcoa has confined its productions to extrusions and sheet and plate, both bare and Alclad.

An alloy developed for pressure vessels is XA54S. This is an Alcoa alloy of the high-strength non-heat-treatable type. The use of the alloy permits substantial reduction in the thickness of aluminum sections used in pressure vessels. This new alloy is currently being evaluated in tank car and other applications.

Another development has been the production of wide tread plate up to 90 in. for thicknesses of .188 in. and heavier. The width has made it possible for highway trucks and trailers to be equipped with single width flooring.

During 1951 further progress had been made by both Alcoa and Reynolds in rolling longitudinal tapered sheet and plate. Wider tapered plate was rolled with uniform thicknesses at the heavy end. Tapered sheet is in considerable demand for production of aircraft of the ultra high speed type.

The use of cast aluminum bearings reached the production stage in 1951. A leading tractor producer has replaced expensive bronze bushings with aluminum alloy B750-T5 bushings in a very severe bushing application.

DUCTILE IRON—

Now available as replacement for critical metals

By
FRANK P. LOVETT
President,
Vulcan Foundry Co.
Oakland, Calif.

OUR EXPERIENCE has shown us that Ductile Iron manufactured under the International Nickel Company process combines the process advantages of cast iron with many of the product advantages of cast steel. Some of the properties of interest to the engineer are as follows:

1. Its elastic modulus, about 25,000,000 psi., is virtually unaffected by composition or thickness.
2. It can provide a chilled, carbidic, abrasion-resistant surface supported by a tough ductile core. No other single material can combine these properties — its only counterpart being a tough material coated with a hard welded overlay.
3. As-cast ductile iron of 93,000 psi. tensile strength has the same machinability rating as gray iron with a strength of 45,000 psi.
4. Annealed ductile iron can be machined at a rate two to three times that of good quality gray iron.
5. It can be satisfactorily welded.

During the past several years industrial literature has exhibited redundant praises for Ductile Iron. We can also read in this literature a great deal of controversy and some criticism. Any arbitration or evaluation of this material dependent upon the industrial press might be misleading. It is the purpose of this article to give our actual experience with this material.

The basic metallurgy involved in producing Ductile Iron consists of the inoculation of the molten iron with small amounts of magnesium in order to produce spheroidal graphite rather than flake graphite as the residual carbon form. The presence of the spheroidal graphite rather than the flake graphite in the mechanical mixture gives this new product ductility and higher strengths completely unique among gray cast irons. The following table illustrates the mechanical properties of Ductile Iron available to industry today.

During the past year we have sought out and applied substitutions for both steel and malleable iron. We have proceeded conservatively and at this time have sold commercially approximately 2,000 tons of Ductile Iron castings as replacements for both steel and malleable.

The basic metallurgy involved in producing Ductile Iron was accomplished within a reasonably short length of time. On the first heat that we took off under the International Nickel Company process we obtained test bars that pulled 85,000 to 115,000 psi. tensile. In addition to the high tensiles, we had a cast material that would bend and twist.

Laboratory determinations convinced us that we were dealing with an entirely new material. It was also apparent that many problems existed in reducing the values obtained in test bars to a commercial casting. Our entire effort during the past two years has been devoted to accomplishing this.

Use of Ductile Iron may be said to be an increasing trend in the Western metalworking industry; certainly more and more manufacturers are specifying it, and new applications are coming to light frequently.

Properties of Cast Ferrous Metals

Grey Iron

Is brittle, with no ductility. Strength range 20,000 to 30,000 psi. Used in applications where shapes are needed, without excessive strength.

Semi Steel

No ductility. Cast in strength ranges from 30,000 to 55,000 psi. Good for machine tool bases and uses where vibration dampening is a factor, and for applications where exceptional castability is desired. Rather intricate shapes can be cast with this material, as with ductile iron.

Malleable Iron

Has considerable ductility, but maximum strength range top limit is about the same as for cast semi steel (i.e., 55,000 psi.). Easily machined. Applications generally where a medium strength material is required with some resistance to shock, and measure of ductility.

Steel

Has high ductility and is cast in strength ranging up to 120,000 psi. Strength can be far greater after proper heat treating. Applications generally are where extreme strength is needed, with resistance to shock and high ductility.

Ductile Iron

Fills the gap between semi steels and cast steel (for strength) and between cast malleable iron and cast steel (for ductility). Normal strength (as cast) is 85,000 to 95,000 psi., but strengths up to 120,000 psi. have been obtained in the as cast condition.

REPRESENTATIVE MECHANICAL PROPERTIES OF COMMERCIAL HEATS OF DUCTILE IRON

	Grade	Tensile Strength, psi.	Yield Strength, psi.	Elongation per cent	BHN	Usual Condition
A	90-65-02	95/105000	70/75000	2.5/5.5	225/265	As-cast
B	80-60-05	85/95000	65/70000	5.5/10.0	195/225	As-cast
C	60-45-15	65/75000	50/60000	17.0/23.0	140/180	Annealed
D	80-60-00	85/95000	65/75000	1.0/3.0	230/290	As-cast

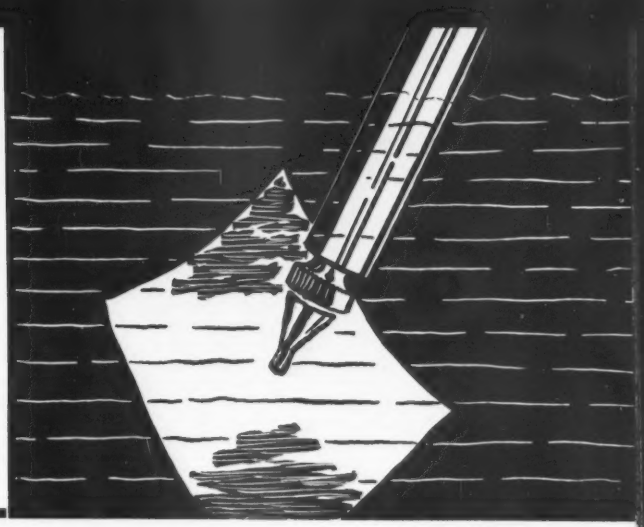
A Pearlitic in structure. Provides good mechanical wear resistance.

B Pearlitic-ferritic in structure. Provides strength and toughness combined.

C A fully ferritic structure usually obtained by short anneal of either (A) or (B). Provides optimum machinability and maximum toughness.

D Higher phosphorus content than preceding grades, also higher manganese. Provides high strength and stiffness, but only moderate impact strength.

TESTING



Hidden flaws found by

UNDERWATER TESTING of METALS

This method starts where others stop. It tells you what's inside

NON-DESTRUCTIVE testing by ultrasonic waves, vibrations too intense to be heard, is rapidly becoming an important factor in the metal fabrication field, and in airframe manufacturing in particular.

A recent adaptation of the process involving immersion of both the part to be tested and the scanning crystal which generates the dirigible beam under water has been developed at Santa Monica division of Douglas Aircraft Company under direction of Chief Inspector H. O. Williams by W. C. Hitt, Assistant Chief Inspector.

W. C. HITT, assistant chief inspector at Douglas Aircraft Santa Monica plant, demonstrating a battery of Reflectoscopes used in underwater electronic inspection of aluminum plates and forgings before machining.

Culmination of Experiments

Experiments for immersed ultrasonic inspection have been conducted for several years by Donald Erdman, of Electro-Circuits Inc., of Pasadena, who was first to realize the importance of immersed ultrasonic testing, and who has designed a line of automatic machinery for the job.

Meanwhile, Hitt rigged a number of tanks at the Santa Monica plant, and for 30 months has had a staff of testing engineers actively engaged in applying the electronic technique to aluminum plates, bars and forgings intended for use in manufacturing the DC-6, C-124, R4D, and other aircraft manufactured by Douglas.

Man-hours Eliminated

So successful has the new method proved that a considerable saving in man-hours of testing has been effected, and at a recent conference of representatives of Alcoa and engineers of six airframe manufacturers in Pittsburgh, agreement was reached for

HERE IS EFFECTIVE COOPERATION

IN RECOGNITION of the pioneer factory installment at Douglas Aircraft, which Mr. Hitt reported at the conference, he was asked to prepare and submit to those interested, a proposed form to be used in circulating the results of ultrasonic tests of defective material. By this exchange of information it is hoped that all who cooperate will build up their knowledge of the performance and limitations of ultrasonic equipment at a more rapid rate than each could do it alone.

List of Firms

Airframe manufacturers' representatives at the conference were R. G. Bassett and R. L. Sorenson of Boeing at Seattle, O. R. Borngesser and Frank Phillips of Boeing at Wichita, E. R. Weiher of Consolidated Vultee at Fort Worth, W. C. Hitt and J. L. Waisman of Douglas at Santa Monica, Charles Albertson of Grumman at Bethpage, N. Y., W. T. Kluge of North American at Los Angeles and 15 metallurgical engineers of Alcoa, including J. H. Alden, Chief Metallurgist; C. H. Cox, Jr., Staff Quality Standards Department, Metallurgical Division; E. H. Dix, Jr., Asst. Director, Aluminum Research Laboratories; J. F. Faulkner, Aircraft Section, Sales Development Division; W. L. Fink, Chief Physical Metallurgy Division, Research Laboratories; T. R. Gauthier, Plant Chief Metal Forge Plant, Cleveland; J. W. Hood, Quality Standards Department Head, Metallurgical Division; H. V. More, Los Angeles, Sales Office; J. B. Morgan, Research Physical Metallurgy Division; Aluminum Research Laboratories; R. W. Rogers, Staff Met. Davenport Works; H. J. Rose, Chief Metallurgist, Castings Division; D. M. Shaffer, Electrical Engineer Coordinating Ultrasonic Equipment; K. F. Thornton, Head Aircraft Section, Sales Development Division; R. A. Wiedmaier, Supervisor Wrought Products, Metallurgical Department, Vernon Works.

While neither the airframe companies represented nor Alcoa are in a position at this time to set up definite standards, it was agreed that a program directed toward that end should be inaugurated.

As in any group discussion many interesting sidelights were brought out and many opinions were expressed as to changes which should be made in specifications, procedures, and techniques covering a wide range of problems.

Agreed Standardization

Probably the most important item on which general agreement was reached was that as soon as possible, all companies present would use one or more of a standard set of test blocks in calibrating their ultrasonic instruments. As soon as these blocks are in common use, they will permit accurate description of ultrasonic settings to be made for any sample. After much discussion it was decided that as a starting point there would be eight blocks in each set. Each block would be of rolled 14S-F 2 in. x 2 in. x 4 in. with a ¾-in. deep flat bottom hole drilled in the center of one of the 2 in. x 2 in. faces and parallel to the direction of rolling. Hole sizes will be in increments of 1/64 in. diameter from 1/64 in. to 8/64 in. diameter, inclusive. Surface roughness of the blocks will be in the range of 90-110 R. M. S. The Aluminum Research Laboratories agreed to investigate the possibilities of manufacturing these standards and making them available at cost. The feasibility of this will be announced as soon as a decision has been reached. If the Aluminum Research Laboratories does proceed, the blocks will be given serial numbers and identified as Alcoa Ultrasonic Standard Test Blocks.

Conference Benefit

Another important result of the conference is expected to be the possibility of writing detailed specifications covering ultrasonic inspection, not now practical because experience in evaluating results of inspection is lacking.

Mr. Hitt has devised an "ultrasonic test data sheet" which with a sheet of detailed instruction is intended to standardize information obtained in ultrasonic testing of aluminum or other materials. He has conferred with members of the staff of Brig. Gen. W. G. Bain of the Air Force at Wright Field to acquaint the military authorities with what is being done to make writing of detailed specifications feasible in procurement of aircraft by the material command.

Points to Be Covered

Aside from this matter of standard blocks there are other points on which there is a lack of uniformity in the ultrasonic procedures. One manufacturer had used 2¼ mc intensity, as does Alcoa in most of its plants. On the other hand Douglas at Santa Monica uses 5 and 10 mc.

ULTRASONIC TEST DATA SHEET

Prepared by W. C. Hitt

1. Plant in which test was made.....
2. (a) Reflectoscope operator's name.....
   (b) Date.....
3. Material: Ferrous ☐ or Non-ferrous ☐
4. (a) Type of material (14ST, 4130, etc.).....
   (b) Size of material (For irregular parts, list thickness section)
   .....
5. Contact scanning ☐ and/or Submerged scanning ☐
6. Forged ☐, Rolled ☐, Extruded ☐, or Cast ☐
7. Other comments.....
   .....
8. Megacycle setting: ½ ☐, 1 ☐, 2¼ ☐, 5 ☐, 10 ☐, or 15 ☐
9. (a) Alcoa serial no. of block to which machine was set.....
   (b) Test block signal no. identifying size of hole in block.....
10. (Note: Machine setting 1" full amplitude height—Set reflectoscope to the blip height from the drilled hole, measure 1" from top to bottom.)
11. List of photographs taken during test:
    (a) Parts being tested.....
    (b) Reflectograms (image in cathode ray tube).....
    (c) Sectioned defect (discontinuity to show type, size, micros, etc.).....
12. Comments on how ultrasonic tests were made (Any difficulties encountered due to surface condition on irregular sections if contact scanning was used; if submerged scanning was used; the angle or angles which best showed up the defects. Any interesting or unusual observations):.....
    .....
    .....
13. Mechanical property test report, if made (size of coupon and estimated size of defect).....
    (Note: A comparison to a test specimen of the same size through ultrasonically sound material in the same specimen being tested, could be made.)
14. Description of defect (Type of discontinuities—lamination, unhealed porosity, chrome segregate, inclusions, etc.):.....
    .....
15. List of enclosures (attached photos, copies of test reports, etc.):
    .....
16. Aircraft Co. where test was made.....
    .....
    (Signature of operator or supervisor)
17. Copies to:
    ....
    ....
    ....

adoption of uniform ultrasonic testing procedures and a set of standard calibration blocks to classify types of flaws in material being tested.

For many applications, immersion in water greatly facilitates testing. Advantages given by Douglas for the use of immersion testing are:

1. A faster inspection rate.
2. Some areas impractical to cover by contact scanning can easily be done when part is immersed in water.
3. By being able to move the crystal through various angles in relation to a specific area on the part, a better idea may often be obtained as to the extent of the discontinuity involved. Power driven heads are preferable.
4. The higher the ray intensity, the greater the working area between the face and back echo, and the less "dead space."

Mr. Hitt stated that frequencies of 15, 20 and even 25 mc may be employed by Douglas. It was realized by many present that the higher frequencies do give in many cases, sharper indications, but it was pointed out that the use of these frequencies also emphasizes some variations in metal structure and minor defects neither of which are considered today to be of significance in considering the quality of the part. Only more experience can indicate a line where the useful limit of sensitivity has been reached.

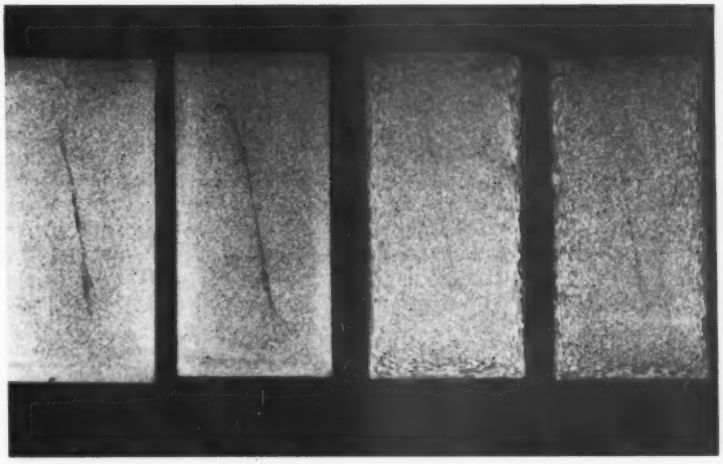
Industrial Uses

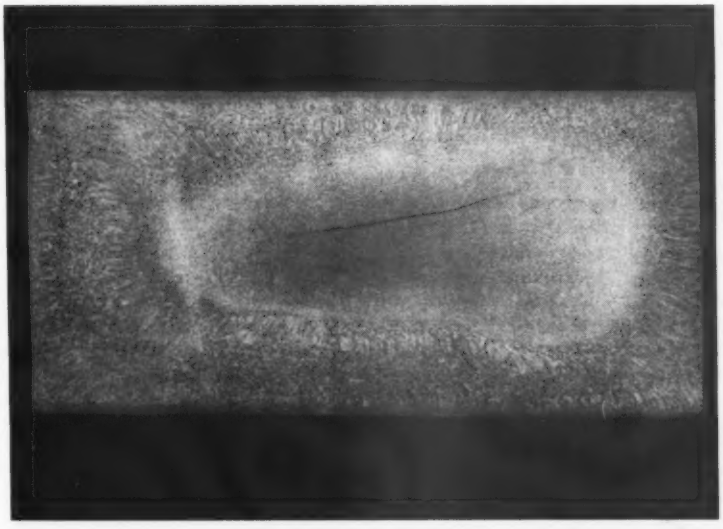
J. W. Hood of Alcoa stated that there are now in use by his company, a total of 17 reflectoscopes with indications that more may be required. In addition to the equipment used in the Aluminum Research Laboratories, Alcoa makes practical use of the reflectoscopes as follows, chiefly using 2¼ mc frequency:

1. Hot rolled blooms for forging stock and rolled structural shapes are inspected for internal soundness prior to subsequent fabrication.
2. High strength ingots for extrusions are inspected for internal soundness.
3. All hand forgings and die forgings where it is feasible are inspected in process and at finish.
4. All heavy gauge 75S plate is inspected at finish.
5. Some plate of other alloys for specific applications inspected at finish gauge.

The general policy of Alcoa continues to be that the reflectoscope shall be used to detect unsatisfactory material in process at as early a stage as possible. The information thus obtained is correlated with metallurgical practices as a quality control means.

In response to a question as to what products the airframe industry will inspect ultrasonically upon receipt, it was stated that present efforts would be directed toward the material for application on the larger and more critical parts which affect the safety of the airplane. Past experience with the quality and performance of any form of raw material will also be a factor.





ABOVE—Types of flaws inherent in extruded aluminum bars, difficult to detect except with immersed ultrasonic inspection. BELOW—Flaw appearing in hand-forged block of metal. It was detected by the method explained in this article.

How High Is Ultrasonic?

Ultrasonic waves are familiar to any recent student of wave motion as those vibrations toward the middle of the radiant spectrum more intense than sound waves but considerably below the intensity of heat waves or "black light."

For instance, the lower notes of an organ cause sound waves of about 30 cycles per second. The human ear can hear sound as high as 20,000 cycles. Dogs are believed to hear a whistle of 50,000 cycles, and the ultrasonic squeak of bats, by the echoes of which they can avoid objects in the dark have been measured at 100,000 cycles, or 1/10 of a megacycle.

Uses of High Frequencies

Frequencies between 25,000 to 500,000 cycles are used for under water signaling, and 500,000 cycles, half a megacycle, is the order of the low limit of frequencies used in testing materials, being applicable only to material which evidences large grain or poor homogeneity.

Higher frequencies, to 15 megacycles, are used in testing of very fine-grained homogeneous material, with

QUALIFIED ENGINEERS NEEDED NOW

ULTRASONIC test work of this type is fast coming into its own.

Non-destructive testing can save many hours of machine time and an impressive portion of operating costs. It can serve as a quick method of determining acceptability of material at the receiving stage. The need for qualified people to do this work is most urgent, Douglas engineers say.

A student preparing for this work should get acquainted with basic metallurgy and make some research into the phenomena of ultrasonics. The field is wide open, and new discoveries are being made every day. Many Douglas employees engaged in this work were trained in laboratory methods by preparing material and doing simple etching. Working with a microscope to analyze flaws and grain patterns has proved helpful. They have also spent considerable time in foundries, rolling mills and forge shops, besides doing practical work in heat treating facilities.

It is a basic prerequisite that the operator know the nature of possible defects and the plane in which they may lie.

five mc the common test frequency for metals and 7½ mc the frequency for producing mercury delay lines. Some experimenters have suggested testing with frequencies up to 25 mc. The highest ultrasonic frequency obtained is around 500 mc.

How It Works

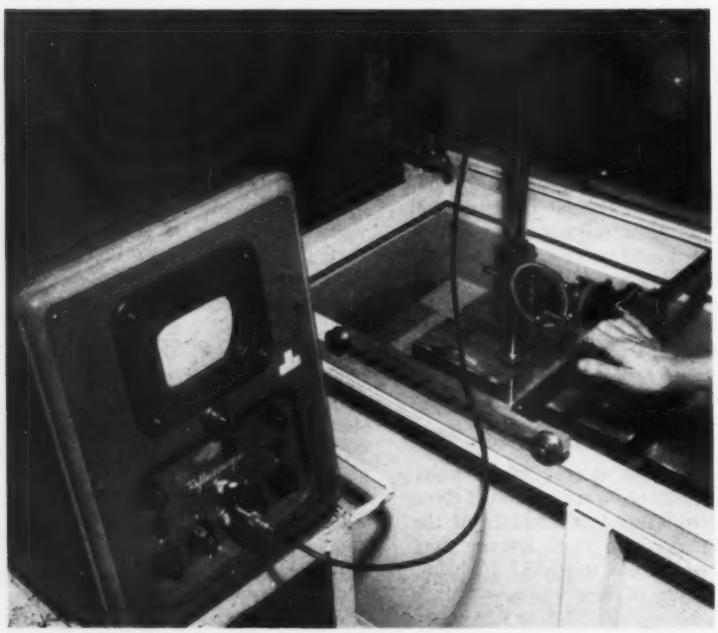
The value of ultrasonic waves in non-destructive testing depends on two qualities—reflection and diffraction. When a wave of any kind strikes a boundary between two media with different acoustic impedance or resistance to the passage of sound waves, at an angle of other than 90 degrees, the wave may undergo a transformation. The direction of the testing wave is therefore, critical, and the latest models of ultrasonic quartz heads are mounted with controls that permit them to move in at least two planes.

The instrument for propagating ultrasonic waves is the x-cut quartz crystal acting as a source of vibration when electrically activated.

Ultrasonic Magic

Waves are sent out in pulses by an oscillator, and between periods of activity the crystal acts as a receiver of the reflected or echoed waves which bounce back from a discontinuity or flaw in the material. They are captured by the crystal and transformed into visible signals on the cathode ray tube.

CLOSE-UP of a test operation at Douglas Aircraft Santa Monica plant. Aluminum bars are immersed in water, and new test apparatus is in process of searching out any possible hidden flaws that lie beneath the surface of the metal.



Reason for Immersion

When the wave passes from the crystal to the material to be tested through air gaps caused by rough interfaces, the diffraction may be so violent as to set up pips on the oscilloscope that could appear as a false signal.

This made it necessary for early experimenters to grind and polish flat surfaces on tested parts to avoid violent reflections of rays passing through the air. A film of oil or grease was then applied to make the transition easier. Finally the technique of immersing both the test material and the crystal scanner in water was found to be the best way to cut down interference "hash."

Much machine time is saved, and it is not necessary to follow the contour of the surface with the scanner, although the scanner may be adjusted so that its beam strikes the surface of the flaw or discontinuity at right angles.

Comparison with X-Ray

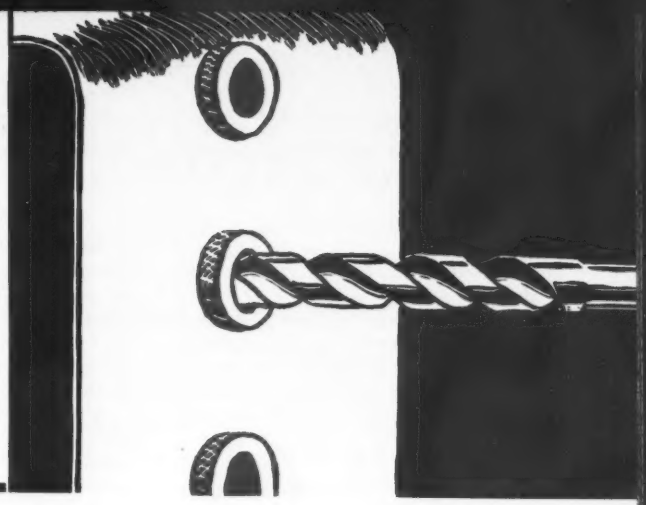
Many times, it is asked how ultrasonic inspection compares with X-ray. There can be no comparison of one method against another, as they do different things. Types of discrepancies found by X-ray probably would fall into the following categories: porosity in metal, cracks, gas holes, incrustations, slag and undercutting in welds. X-ray also permits examination of inaccessible areas such as the inside of welded tanks or assemblies and the investigation of some types of forgings.

In order to locate a crack type defect by X-ray, it is necessary to know the direction of the crack within 10 or 15 degrees so that the X-ray traveling through the crack would produce its image on the film or plate.

Ultrasonic testing works in the opposite plane, and the direction of the ultrasonic beam should be at least a slight angle to the plane of void, so as to generate back echo enough to cause investigation. The range of ultrasonics is many times greater than the highest power X-ray or radioactive isotope.

Workers in the Douglas laboratories have been able to penetrate up to 35 feet of aluminum with the reflectroscope. This would not be possible with the highest powered betatron. The ultrasonic operator would not hesitate to test a piece of steel 10 feet in thickness, a task impossible for X-ray apparatus.

TOOLING



How PLASTIC TOOLS benefit the subcontractor

By

P. LE ROY VENABLE

Supervisor of Pattern Shop and Foundry
Northrop Aviation, Inc.,
Hawthorne, Calif.

DIES AND FIXTURES made of plastic may go a long way toward solving the small plant's vexing problem of rising costs, die metal scarcities, and skilled manpower shortage.

Not only is plastic tooling as effective as cast metal tooling, and able to do whatever the metal will do, but the cost of tooling is shaved sometimes as much as 65% to 70%.

Valuable for Short Runs

Plastic tooling is not necessarily a "stopgap" method, or substitute for something better. It can stand on its own two feet. For example, one of its benefits is its use for short-run production, where metal tooling would cost too much to be economical. Fixtures originally designed and made at Northrop, for example, and intended to make only a few dozen parts, have made as many as 1,300 parts and are still ready to turn out more. Accuracy remained in the plastic tools.

In conference with a *Western Industry* editor, LeRoy Venable, Northrop Aircraft's foundry and plastic tooling shop supervisor, stated that many of the techniques used by Northrop in fabricating its twin-jet interceptor, the Scorpion (F-89), are readily applicable to the tooling problems of many smaller fabricators.

For shops contemplating using plastic tooling, Mr. Venable has a few words of caution. "Plastic in reality won't do anything metal won't do," he says. "But in cases where shops are kept from much metal tooling because of prohibitive costs, plastic tooling can be done effectively, and within reasonable cost limitations. Once the plastic tooling is made, it is just as effective as the more expensive cast metal tooling, and it is able to do what the metal will do."

LARGE PLASTIC MASTER is shown being poured in the Northrop shop at Hawthorne. Tool made was used on part of Scorpion F-89.

No Special Equipment

No special equipment is needed in the small shop, Mr. Venable explains. Small plastic forming tools can be used with the equipment on hand—such as small hydro presses and arbor presses which most shops have. Check fixtures, drill fixtures, assembly jigs and masters, trim fixtures, glass laminating mandrels, electro-forming matrix—all of these can be made by use of plastic rather than metal.

The ease with which plastic tooling can be made enables smaller shops to compete in costs with the larger companies. If the small manufacturer had to farm his tools out to be made, his ability to compete would be considerably lessened.

Making of hand routers and drill fixtures by use of plastic tooling in a small shop requires a minimum of personnel. The shop should have a plaster pattern maker. His job would be to make the male plaster mock-up and pull the female cast which would be used as a mold for phenolic tooling. He would be required to make the core and all other pertinent components

such as trim lines, etc. Then either a plaster pattern maker or a phenolic tooling man would mix the phenolic and pour.

Curing must be done in an oven large enough to hold the tooling, and able to maintain a temperature of 200 deg. F.

Use of plastic tooling in a small shop follows in effect a pattern similar to that used by Northrop in its plastic shop—with the same materials being used and the same general procedure being followed.

Currently in use at Northrop is "Rezolin 8000," a thermosetting plastic of the phenolic group, a product of Rezolin, Inc., of Los Angeles, California, and P.R.-500 "Kaston," manufactured by Poly Resin, Sun Valley, California.

They both produce a high density casting with a glossy finish that is easy to obtain. Repairs, rework and changes, as the case may be, can be made with a minimum expenditure of time and effort. Material can be removed with standard shop equipment. Addition of plastic material can be made by roughing up the existing surface, enclosing the tool in a suitable plaster cast, and re-casting.

Making the Mold

Generally, successful and economical fabrication of plastic tools or sections of tools lies in the use of plastic in conjunction with plaster mock-ups, plaster patterns and plaster flasks. Use of plaster provides an economical means of taking an impression of the section of the mock-up related to the plastic tool to be fabricated. This same impression cast, in turn, often becomes the face of the mold for the plastic material, as well as part of the casting flask.

Plastic tools may also be made directly from a sample or master part using plaster or clay to support the part and form the desired shape of the fixture and then enclosing with a suitable flask for casting.

Methods of Production

Methods of producing a plastic cast cannot be restricted to set procedure because of the variety of tools to which plastic may be applied. Each type of cast is an individual case and is governed considerably by the related tools in the fabrication procedure.

A wall thickness of not less than one inch and not more than 1½ in. is recommended for plaster patterns.

A plaster pattern must be dried thoroughly. After drying, it receives two coatings of "sanding sealer," with a light sanding between coats, and a final sanding after application and drying of the second coat. On top of this go several coats of lacquer, providing a glossy finish. Following drying of the lacquer, a final polish is provided with a wax (paste type) which is applied with a soft cloth. The wax expedites removal of the plastic cast.

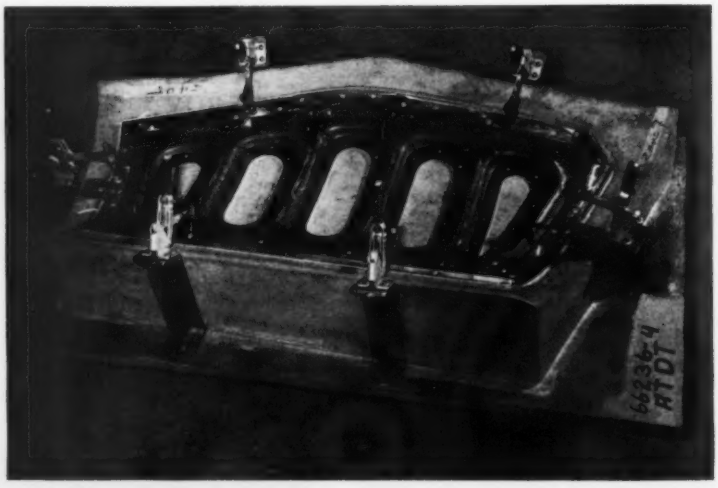
Now that the pattern is made—and a careful check has been made to see that it contains no flaws and is of correct dimension, the tool plastic is ready to be mixed and poured.

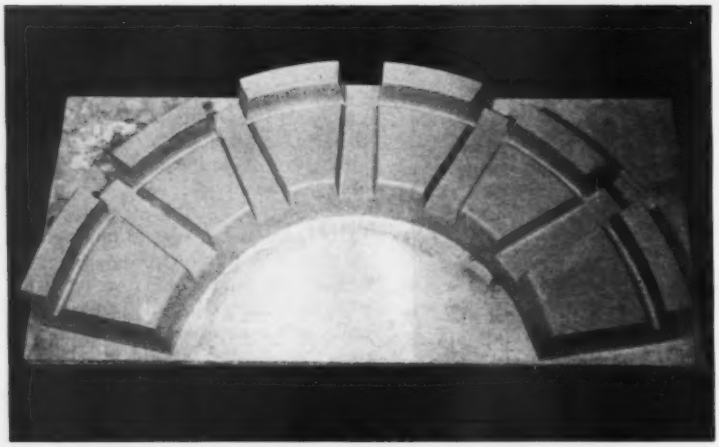
The plastic is carefully weighed and mixed, slowly poured into the mold. It is allowed to set for about two hours, to allow bubbles to rise. Then it is placed in an oven for curing. Following Northrop shop practice, an oven curing temperature between 160-170 deg. F. is recommended. The time required for curing, of course, depends upon the size of the casting being cured.

After removal from the oven, the casting stays in the mold until it is completely cold.

When the curing is finished, sanding and additional polishing puts the casting in finished form.

A typical example of the type of plastic tooling possible in a small shop would be the welding, drilling and assembling of an air duct for a jet engine. The assembly fixture, weld fixture, and drill fixture could all be made from phenolic taken directly from an original plaster mock-up, thus assuring perfect coordination.





ABOVE—Typical combination trim and drill fixture using plastic material as the base and nesting surface. Aluminum base is used to support the plaster.

LEFT—Finished check fixture, having relief cutouts and nesting surfaces. This sort of tool can produce parts as well as be used as a go and no-go check tool.

BUSINESS IN MOTION

To our Colleagues in American Business . . .

The Revere Technical Advisors call upon manufacturers from coast to coast, when requested to collaborate on special problems concerning the selection, fabrication or application of copper and copper alloys, and aluminum alloys. The procedure is this: the T.A. sits down with the customer or prospect, and together they study the project put before them by circumstances. It is a close collaboration, a joint effort that frequently results in marked improvement in quality or lessening of costs, or both. Here are some examples:

• Customer staking diamond inserts in free-cutting brass rod reported that the rod was turning color under the diamond, resulting in rejects. The brass was machined with a water-soluble oil, and cleaned with a special preparation. It was discovered that parts machined with sulphur-bearing oils were being cleaned in same container. This was the cause, and the obvious remedy eliminated discolor.

• Plumbing goods manufacturer was puzzled by the fact that brass tube purchased in small grain sizes for good plating qualities was giving both bending and plating troubles. Inspection of the processes of the manufacturer showed that the tube was being annealed with a torch before expansion and plating. This annealing resulted in a large grain size of .250 mm., as shown by a typical sample sent to the Revere Laboratory. Thus the apparent anomaly was explained, and close control of annealing was established to keep grain size within the necessary limits for satisfactory plating.

• An electrical manufacturer was using a very special and expensive copper alloy as a liner for a plunger housing. He felt this extremely hard alloy was necessitated by the large amount of wear on the part. Revere suggested that Herculoy, a silicon bronze, would be worth trying in hard temper. Tests were made, and the Revere alloy was found completely satisfactory. Substitution provides a metal that is more easily available, and at the same time costs less than the original.

• A maker of a timing device was having trouble blanking cleanly a small gear part. Detail was so fine and ratio of tooth height to width so great that leaded brass had a tendency not to form full teeth. A study of this problem brought forth the suggestion that a more ductile metal was needed, namely, ¾ hard cartridge brass. This worked beautifully when tried, and customer is extremely pleased with the tremendous reduction in rejects of this difficult part.

These are just a few of a number of cases that went into the "closed" file during a single month. Almost every other supplier to industry today does much the same sort of work with his customers. He feels it is not only a fine way to build good will, but also a part of his obligation to the customers who have helped him grow. It is a fact, of course, that every dollar you pay, whether for chemicals or metals, glass, cements, papers, carries a small charge for the research and know-how and skill required to make fine products. Your suppliers have knowledge you have helped pay for — why not use it as well as their materials? The results may be as pleasing as those in the four instances just cited.

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FORMING

New developments in

RUBBER HYDROPRESS FORMING

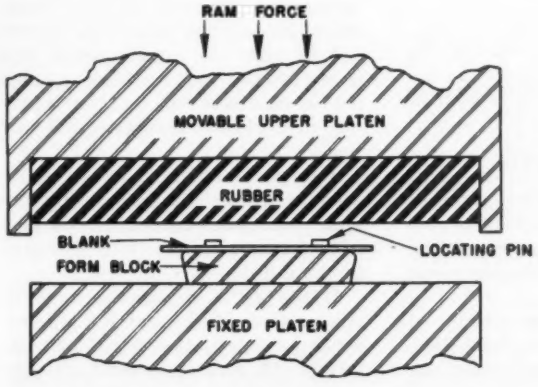
reduce man-hour finishing time 80%

RUBBER HYDROPRESS forming (a process in which a rubber mat under pressure "flows" around a die to form the part) has been recognized and used for several years by the metalworking industry, principally because of the relatively low cost of tooling.

However, it has an inherent drawback in that it does not produce a perfect part: considerable hand finishing is required. Getting rid of the hand operations has plagued all the production-run users of this method, and various methods have been evolved to accomplish that objective.

At North American Aircraft, in Los Angeles, three methods have been adopted, which greatly reduce the number of man-hours required. For example, in 1947 approximately 10 man-hours of hand finishing were required to support one hour used at the rubber-form hydropress machine. In 1950 this had dropped to 1.6 man-hours of finish time per man-hour at the machine.

This has been done through use of a high-pressure rubber-form hydropress adapter, the draw-forming "clip," and the "mechanical lead slapper," all developments of North American's hydropress department personnel. This is what they do and how they work:



SCHEMATIC diagram of rubber hydropress forming, showing the mat of rubber about to be forced down on a metal blank and form the piece around a form block on the press. This method is good, but it has some inherent drawbacks that North American engineers removed.

Rubber Forming

A rubber form hydropress, using a reasonably large die table (54 x 126 in.) is normally operated at pressures from 1,100 to 1,250 psi. Such a press can be made to exert much greater unit pressure by simply reducing the size of the die table.

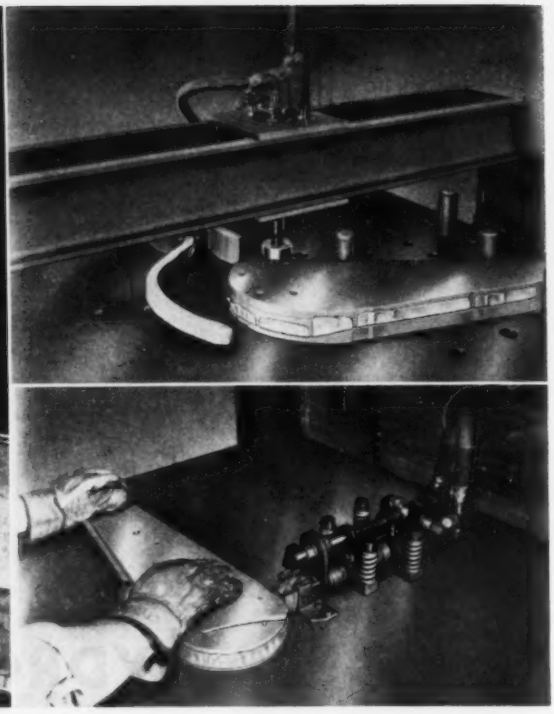
It has long been known that higher unit pressures would form both convex and concave flanges better. Under compressions, as in a convex flange, material thickness is a major factor; the thin gauges wrinkle much more than do thick ones, and the necessary handwork for completing them is disproportionately higher.

Higher pressure forming can minimize the wrinkling. It also makes possible the forming of much heavier gauges than the conventional (1,100-1,250 psi.) method will allow.

An increase of hydraulic pressure on the hydropress ram to produce 8,000 lb. at the table was not feasible with current equipment at the time this development started; so the size of the table was reduced to accomplish the same end.

By the judicious selection of sheet

THE NEW . . . way to form sheet metal parts, shows a forming clip being placed on the blank. Small shops can use this method.



ABOVE—Mechanical lead slapper now replaces muscle. BELOW—Pneumatic hammer, now used to finish flanges.

metal details to fit this table, parts with convex or "shrink" flanges and joggles or which could be formed while in fully heat-treated condition (vs. annealed condition for normal pressures), a material saving in handwork was realized.

The press setup for high pressure rubber forming has two platens, alternately positioned under the ram by an automatic cycling device, and an operator works at each side of the machine, loading and unloading.

Clip Forming

Development of the draw form clip now permits much wider flanges to be formed with the economy of hydropress tooling without resorting to punch press draw form dies or to the hand forming of each individual piece.

As an outgrowth of the draw ring, the draw clip can be more universally applied to sheet metal forming than any other type of draw ring yet used; it does not have to encircle the die to give satisfactory results.

It works on the same principle as the punch press draw form die by restricting the flow of metal and preventing wrinkles while the part is being formed.

The draw-forming clip appears to be a rather loosely operated device; a sheet metal blank is placed on a form die on the hydropress platen and a clip is slipped over the edge. The ram comes down and is retracted. The clip ends up lying on the table, and a completely formed part may be lifted from the die.

THE OLD . . . fashioned way isn't good enough any more. Mechanization of muscles is the trend.

Limits of Draw Clip

This clip, made from three pieces of 75S-T6 aluminum alloy sheet riveted together, performs the same operation on a hydropress that a punch press die with draw ring does.

There are limits to the amount of work a draw clip can do, about 25% shrink or stretch, but these limits are far above what normal hydropressing will do. Annealed aluminum alloys can be made to stretch about 20% or shrink up to about 6%, depending upon thickness, under the rubber at 1,100-1,250 psi.

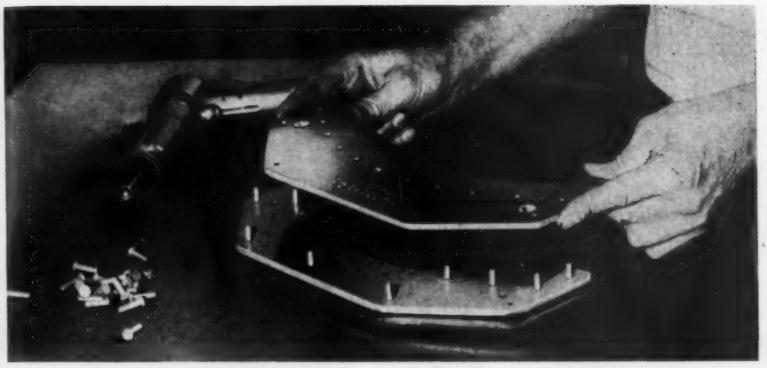
After forming, the part is removed from the die (the clip disengages completely as part of the form operation) and is sent to the pneumatic hammer table for removal of the curl in the edge. This curl, indicated in the last stage in the picture, results from the disengagement of the clip with the edge of the blank and does not provide enough area for the rubber to press on after the clip has dropped to the die table.

Inexpensive to Make

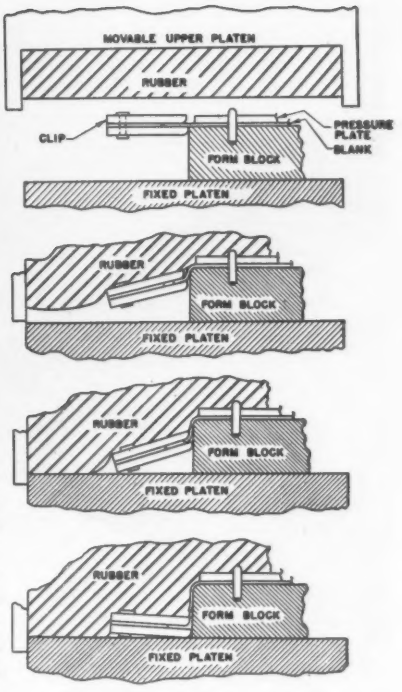
Draw clips are inexpensive to manufacture, requiring about three manhours per average clip. The use of 75S-T6 bare alloy came about after trying many other metals which proved unsatisfactory because of galling, distortion or complete deformation.

Two pieces of 75S-T6 plate sandwiching an aluminum spacer (approximately one gauge thicker than the part to be formed) are cut to the shape of the form die.

If the included segment angle is greater than 70 deg., or if the bevel angle is closed, the upper plate is further cut back an amount equal to



ASSEMBLY of a typical draw clip as it is practiced at North American. These clips are simply constructed of easy-to-obtain pieces, and any shop can make them.



SCHEMATIC diagram showing the complete process of forming a part with a rubber hydropress and new draw clip, as explained in this article.

the thickness of the part and the lower edge is rounded off. This thickness allowance and radius are cut by a vertical shaper. The spacer is cut to the shape of the blank before forming. Then all three pieces of the clip are riveted together. Tolerances on clearance between die and clip are not as critical as those applied to punch press form dies.

Accompanying photos show the hydropress table with several dies in before-form and after-form stages. Note that the draw clips encompass only those which have severe shrink or stretch, the balance being formed by rubber in the conventional manner. Where the clip is not completely self-aligning, the die is so placed that the clip is backed up against the side-rail of the table, or a 2½-in. square bar is used to hold it in position while forming.

Stretch Percentages

Both open-bevel and closed-bevel flanges can be formed by draw clips. The clip is guided and held close to the form die by one or more blocks. This shows a distinct advantage over the punch press method (90 deg. flanges) or the drop hammer (open bevels).

Maximum flange width limits are greatly expanded by the developments described here. In forming stretch flanges with clips the percentage of stretch may be as much as 25% for 24S-0 and 75S-0. (No ratio has been determined yet for the heat-treated conditions of these alloys.)

Edge Conditions

On a concave flange the clip restricts stretching along the very edge until it is pressed far enough to disengage from the part and in doing so helps to prevent a local fracture.

The 25% figure quoted above applies to an edge condition made by routing. Other types of edge conditions not so smooth, such as those produced by shearing or blanking, limit the permissible elongation to much less than that.

On the other hand the included segment angle will have an influence on the percentage of "stretch" approximately in the ratio shown in the chart for concave flanges, for routed edges only.

About Shrink Flanges

The convex or "shrink" flange is more difficult to form by the hydropress than is the stretch flange, due to its tendency to buckle. Depending upon material thickness the rubber will compress annealed aluminum alloys up to about 6%. Above this figure, it is preferred to omit relief cutouts and form by the clip method.

For maximum percentage of shrink in convex flanges formed by draw clips the 25% figure, as in stretch flanges, may be used as calculated in the chart for convex flanges. The annealed aluminum alloys (24S-0, 75S-0, etc.) may be formed into shrink flanges with as much as 25% shrink. No figure is yet available for these alloys in heat-treated condition.

Lead-Slapping

"Lead-slapping" is still a standard method of hand finishing in most aircraft factories. The operation involves taking a semi-finished sheet metal part as it comes off the hydropress, clamping it, together with form die and pressure plate, in a vise, and removing the wrinkles from the flange by slapping with a lead bar similar in shape to bar solder. This is time consuming, and hard work. Hydropress department personnel developed the mechanical lead slapper to reduce the "hard" part of the work and to speed up the operation. The machine may be seen in two accompanying photos, one showing the reciprocating lead bar which, being pivoted around a spindle, moves through an arc against the sheet metal part and form die. This is a mechanization of a tedious mechanical operation, welcomed by shop men.

Pneumatic Hammer

The curl that remains on the edge of any part formed by a draw clip is quickly and easily removed on the pneumatic hammer. This is an adaptation of the ordinary rivet gun, with a pad of phenolic or red fibre attached to the business end. This is used to set joggles (i.e., give them the proper profile of the form die).

The operator presses the form die and sheet metal part against the fibre block, automatically setting the air hammer into operation. By moving die and part laterally across the face of the fibre block, this gives definition to the joggles.

Both lead slapper and rivet gun are on one table, available to the operator by a twist of his body.

These innovations have reduced the total amount of hand work done in the hydropress department by one-third to one-half, without the necessity for more expensive types of tooling such as punch press dies or hydropress wedge dies.

It is significant of the trend to mechanize, and of the typical Westerner's approach to more production with less man-hours.

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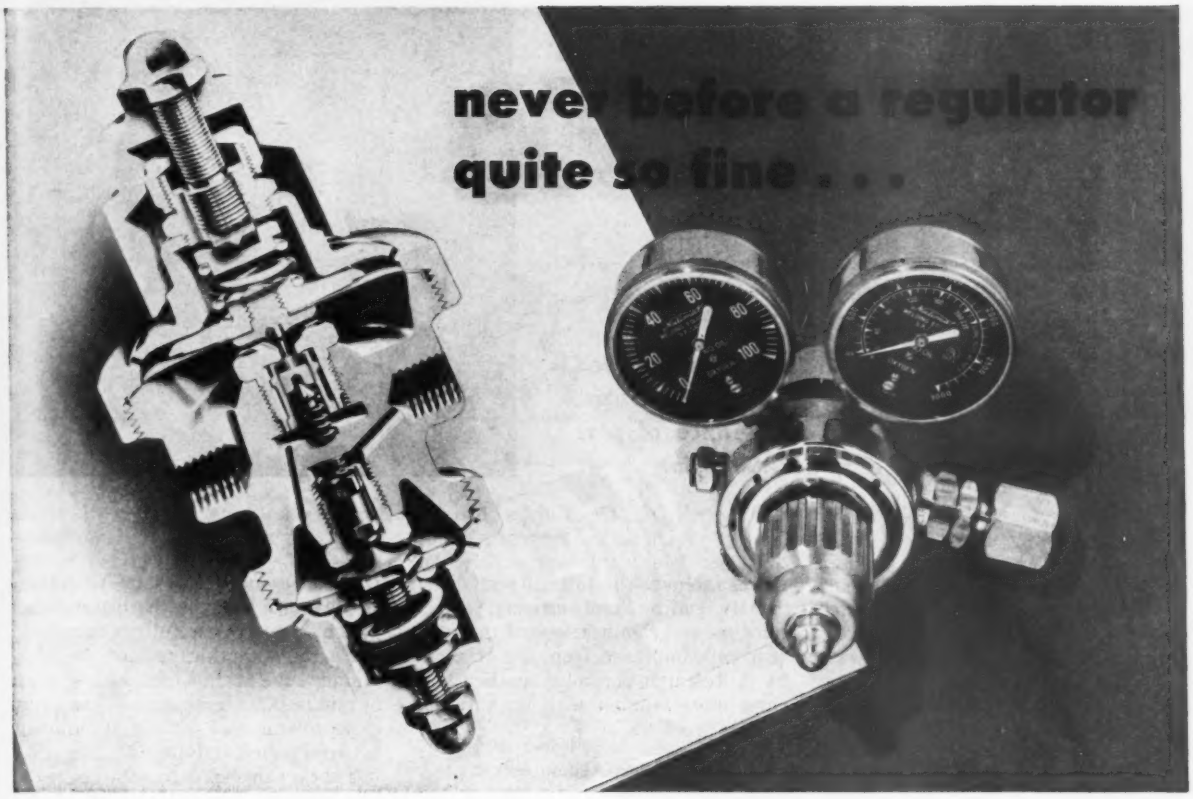

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with IMPACT EXTRUSION

Three-foot tubes extruded from aluminum slugs, with a tolerance of plus or minus .0005 in.

PRIOR TO 1941, tubes used in aircraft heat exchangers were supplied from various sources in the East. However, the supply was limited and the strict Air Force requirements of a scratch-free tube of .0065-in. wall thickness with a tolerance of plus or minus .0005 in. was of a higher quality than was available at that time.

Problem Tackled

AiResearch Manufacturing Co., Los Angeles, tackled the problem and within a matter of months was producing acceptable tubes on a large volume basis. During the past ten years improvements have been constantly made throughout the process, and today the company is the largest producer of small diameter extruded tubes west of the Mississippi.

Like many other developments at AiResearch, the aluminum tube extrusion process was a cooperative project with engineers, metallurgists, lab technicians, designers and production line personnel all contributing their experience and knowledge. The company's suggestion system played a very important part in solving many of the problems.

Equipment

A Hooker impact extrusion press was used as the basic model. This type of press was required rather than a hydraulic press, as enough heat had to be generated to create a high material surface temperature and to maintain enough heat along the die to complete the extrusion process satisfactorily.

It is estimated that a surface temperature of about 900 degrees is generated a fraction of a second after impact. The rating of the press which drives the punch is 150,000 pounds.

All feeding mechanisms, dies, punches and ramifications of the system were improved from the original by AiResearch personnel as they became more familiar with the process and its problems.

Squirting Aluminum

This aluminum tube extrusion process is one of downward extrusion, and is best termed descriptively as "squirting." Briefly, an aluminum slug is placed in a die bushing and then struck with tremendous force by a press-driven punch. Under the resulting pressure and heat the metal is squirted downward through the space between the die and the punch, forming a long continuous tube of aluminum. The actual extruding operation takes less than a second from start to finish.

Clearance between the die and the punch is very carefully controlled. Since the wall thickness of the aluminum tube is .0065 in. with a plus or minus .0005 in. tolerance—an even closer tolerance of .0002 in. is required between punch and die.

Tubes can be extruded up to a length of 36 inches, the length of the tube controlled by the length of the aluminum slug. Less than one-tenth of one per cent of the tubes have to be scrapped. In more detail the various steps in the extrusion process are as follows:

Start with Slugs

Aluminum slugs are cut from bar stock that has been carefully selected and tested according to rigid specifica-

STEPS IN THE PROCESS

(left to right)—

WASHING aluminum slugs to eliminate foreign substances that may later weaken finished tubes.

PUNCHED and straightened slugs moving into extrusion press.

TUBES EJECTED from press (at 900 deg. F.) are hot to handle.

GENERAL VIEW shows newly-cut slugs (lower right), slugs straightened and punched (lower left), inspector (right background) checking tolerances of newly-extruded tubes. Stacked at right center are newly-extruded tubes that have passed inspection. Girls in background are straightening out tubes.

tions. A multiple-bladed cutter performs the job, supplying a continual flow of the slugs. Originally, slugs were sawed, consuming a much greater amount of time and labor.

The slugs are next tumbled and washed in revolving wooden drums to remove burrs, oxide and dirt. Special detergent solutions are used in this process to eradicate any foreign matter that may interfere with the extrusion of the tube.

Annealing in Process

Next step is annealing the slugs, and then they are put through another special bath. The slugs are then flattened to remove any distortion caused when they were cut from the bar stock. At the same time a hole is punched into the center of one end of each slug, into which the forming punch fits.

Once again the slugs are annealed and washed in special solutions. Continual attention to washing is of prime importance, for most trouble has been traced to foreign matter being extruded into the tube.

A lubricated coating is applied to the slug to prevent further corrosion before being extruded.

Then the slugs are extruded as previously explained.

Extruded tubes are straightened, cut to size, and heat treated. Final processing is dimpling, to give them added strength and more surface area for heat transfer.

Problems Encountered

Problems encountered in developing the above process were numerous. Daily, new things cropped up and had to be corrected. One factor that actually helped rather than hindered development was that most of the persons who worked on the project had no previous experience in extrusion work, although they were all experts in their own fields.

Their fresh approach to the subject had a great deal to do with the solving of the problems. No one was there to tell them that something could not be done, and no one had tried previously and failed. In fact, many of them today watch the product of their combined efforts with amazement, as the squat slugs flow into long paper-thin tubes.

Hydrostatic Pressure

One of the chief problems was of hydrostatic pressure of metals—involving the right combination of alloys, amount of pressure necessary to soften the slug, and the annealing and heat treating of the slugs and the extruded tubes.

Tooling also proved to be a knotty problem. Forming punches and die

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bushings were made of high test carbon steel with a tolerance of .0002 in. To maintain a tube tolerance of .0005 in., punches and bushings had to be continually changed.

This was relieved somewhat by having various sizes of punches. As the bushings increased in diameter, a larger punch was used.

Diameter of the tube is actually of minor importance, the critical factor being the thickness of the tube wall both from a weight angle and a heat transfer efficiency angle. An oil cooler, for example, may contain 1,000 tubes which, if they were all overweight, would cut down tremendously the cooling efficiency of the unit.

Other problems involved lubrication of the slugs, defective bar stock, and tube defects that occasionally showed up for no apparent reason. When a defect appeared, the whole process had to be checked before any further production was possible. Nipping defects in their early budding stages is still the job of the inspection crews who work in very close conjunction with the extrusion operators, heat treaters, slug processors and others.

Typical Problem

A typical problem which arose in the past was the time aluminum bar stock of the wrong type was inadvertently used along with the regular stock. Everything went fine until the final heat treat stage was reached; then suddenly some of the tubes turned as black as night. The error was traced and the black tubes were segregated and scrapped.

Another time tubes started to corrode after extrusion. Hundreds would be rejected after the trimming and straightening process while they were awaiting assembly. After weeks of checking, a caustic soap used in the *first* washing was eliminated and the corrosion stopped. The corrosion remained hidden during the whole process only to come to life after the tube was completed.

Still again, reports from maintenance men in the field stated that tubes contained particles of metal, which seemed impossible after the careful washing process and rigid inspections. The trouble was finally discovered. Containers in which the slugs were carried from one place to another for annealing, washing, etc., were made of cold rolled steel which became rusted. Weight of the slugs caused particles of rust and metal to become imbedded in those slugs in contact with the walls of the containers. The particles were then extruded right into the tubes. Later in use and under pressure, the particles came loose. The solution was to line all containers with stainless steel or aluminum.

Pressure created by the oil circulating through the tubes resulted in another problem. It was discovered that sometimes a whole series of heat exchangers would start leaking oil through tiny pinholes in the tubes after being in service a certain length of time.

Why Precision?

Since a heat exchanger literally breathes in oil or fuel under great pressure, the tubes are subjected to considerable stress. A tiny pinhole is rapidly enlarged under pressure resulting in loss of the liquid. This defect was finally traced back to faulty bar stock which contained tiny foreign particles missed by usual inspection and testing methods. The tiny particles were extruded into the tubes and then either corroded out or forced out by the pressure of the circulating oil.

FINISHED TUBES reach their ultimate destination in the heat exchangers, shown here in assembly process.

Still another problem resulted when copper was extruded. The machines had to be very carefully cleaned so that no copper was extruded into the aluminum tubes, which could cause trouble later when brazing them in the final assembly.

Cooperative Project

As stated earlier, this has been a cooperative project—a challenge to everyone at AiResearch. Although extrusion is a smoothly running process today, turning out more than 125 tubes per minute, improvements are continually being made. Skillful operators and alert supervision, trained by trial and error methods, are passing their knowledge on to others, confident not only in their finished products but in their ability to handle any situation that may arise in the AiResearch aluminum tube extrusion process.

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A new Western development—

FORMING METAL by SHOT BLASTING

"PEENFORMING" is the name of one of the latest Western-developed methods for forming metal. This method achieves its result through pelting the surface of a metal part with round metallic shot thrown at a relatively high velocity. It is a type of shot peening differing from the customary kind chiefly in its objective. Ordinarily shot peening is used to improve the fatigue life characteristics of metal parts.

The technique of peenforming is currently being applied at Lockheed as a means of attaining the fore and aft curvature on the revolutionary integrally stiffened wing panels.

It Grew From Here

It is true that a rudimentary type of peenforming was practiced in the horse and buggy days. The oldtime blacksmith knew that by using a ball peen hammer he could with many tiny blows straighten a cold rod of iron or steel. It is also true that today axles and ring gears are being straightened on a small commercial scale by shot peening. But these are secondary forming processes applied to rid the parts of imperfections.

The new peenforming differs in that it is a primary forming method capable of achieving results with a highly complex part.

How to "Sculpture" a Wing

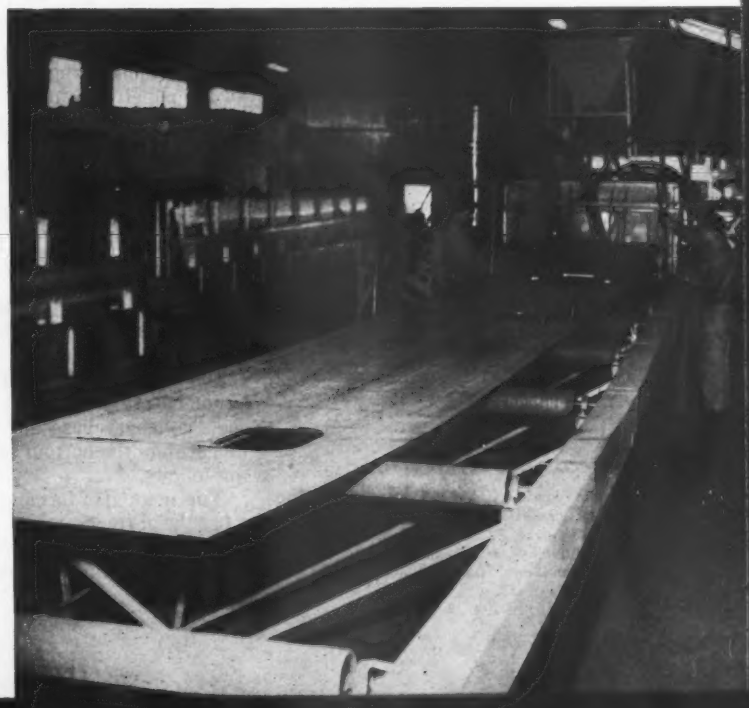
The wing panels, consisting of skin and stiffeners, are "sculptured" from a solid slab of aluminum on giant skin mills, and while they represent a drastic simplification over the conventional multi-piece skin-and-stiffener structure (eliminating 1,500 separate parts and 5,000 rivets in a 32-foot wing section), they are nevertheless a complicated part. The peenforming apparatus, for example, must be capable of bending a wing section uniformly which may run from a

IT GOES IN HERE . . .

and passes through the peenforming machine. Hopper on top contains fine round metallic shot. Six nozzles distribute it.

AND COMES OUT HERE . . .

after having the forming treatment. A vacuum system recovers the spent shot. Banks of panels on left are ready for peenforming.



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thickness of .050 in. to ½ in. within the space of two inches.

Peenforming was developed in a rather oblique fashion.

Lockheed Aircraft Corp. engineers, who developed integrally stiffened wing panels, were searching for a means of forming the panels to the required curvature for lift. (The sculpturing process leaves the panels with a flat outer surface.) Since they were cut from 75S-T6 aluminum alloy, conventional cold forming methods were automatically ruled out and it was decided that hot forming would be used.

Room for Improvement

Later the engineers recognized the fact that hot forming was not a satisfactory answer. Due to the configuration and size of the panels—some up to 32 ft. in length by 46 in. in width—they presented too great a problem from the standpoint of handling. This with the amount of tooling required made the method impractical. Cold forming had to be reconsidered.

It had been rejected previously because calculations showed that conventional cold forming gave rise to a surface tension condition in excess of 20,000 psi.—a highly undesirable thing because of stress corrosion characteristics. As Lockheed engineers reconsidered the problem, James Borger, production methods engineer, suggested that the tensile side of the panel be shot peened, thereby relieving the stress condition. Borger's idea was adopted.

Fred K. Landecker, shot peening expert and manager of Metal Improvement Co. of Los Angeles, was brought into the project and test runs soon got under way. The time was June 1951. It was soon learned that the stress condition could, indeed, be relieved by shot peening and *more*—that by bombarding the outer surface of the panel with metallic shot alone, the part could be formed to the desired contour.

(The curvature required is an approximate radius on the inboard end of 300 in., and on the outboard end of 180 in.)

Here's How

Simply and briefly explained, the bending results from the fact that peening the top surface of the panel forms a compression layer. Because of the nature of compression that surface is lengthened and thus, being longer than the bottom surface, bending follows.

This method of forming gives rise to a beneficial compressive layer on both the upper and lower surface: the upper because of peening and the lower because of bending. The benefit lies in the fact that fatigue fractures do not originate or cracks propagate in compressively stressed material.

FRED K. LANDECKER, manager of Metal Improvement Co., and a developer of peenforming method, inspects "I.S." wing panel about to enter peenforming cabinet.

Tested and Proved

After tests proved the soundness of the process a special machine was engineered and built by the Metal Improvement Co. It is 75 ft. long and consists of two conveyor tables on either side of a peening cabinet plus auxiliary equipment. Wing panels pass slowly through the cabinet from one table to the other. Inside the cabinet are six nozzles from which metallic shot is sprayed by means of compressed air. The intensity of the shot is closely controlled. After an operator familiarizes himself with intensity requirements, a wing panel can be formed in one pass through the cabinet. If for any reason the part is overformed, it can be peened on the opposite side to reduce the curvature.

Other Applications

Integrally stiffened skins that warp in the plane of the skin due to residual stress in the plate stock can also be straightened by peening. This applies generally to long narrow sections. The process involves peening a narrow path on the inner and outer surface along the concave edge.

Peenforming has been in the production stage for some time now at Metal Improvement Co., and results have been highly satisfactory.

Within the past few years a number of new and valuable applications from the general shot peening field have been developed, such as the use of shot peening for eliminating porosity in aluminum die castings and the improvement of oil retention properties of bearings. The new application of peenforming—a Western development—appears a particularly significant application in the field.

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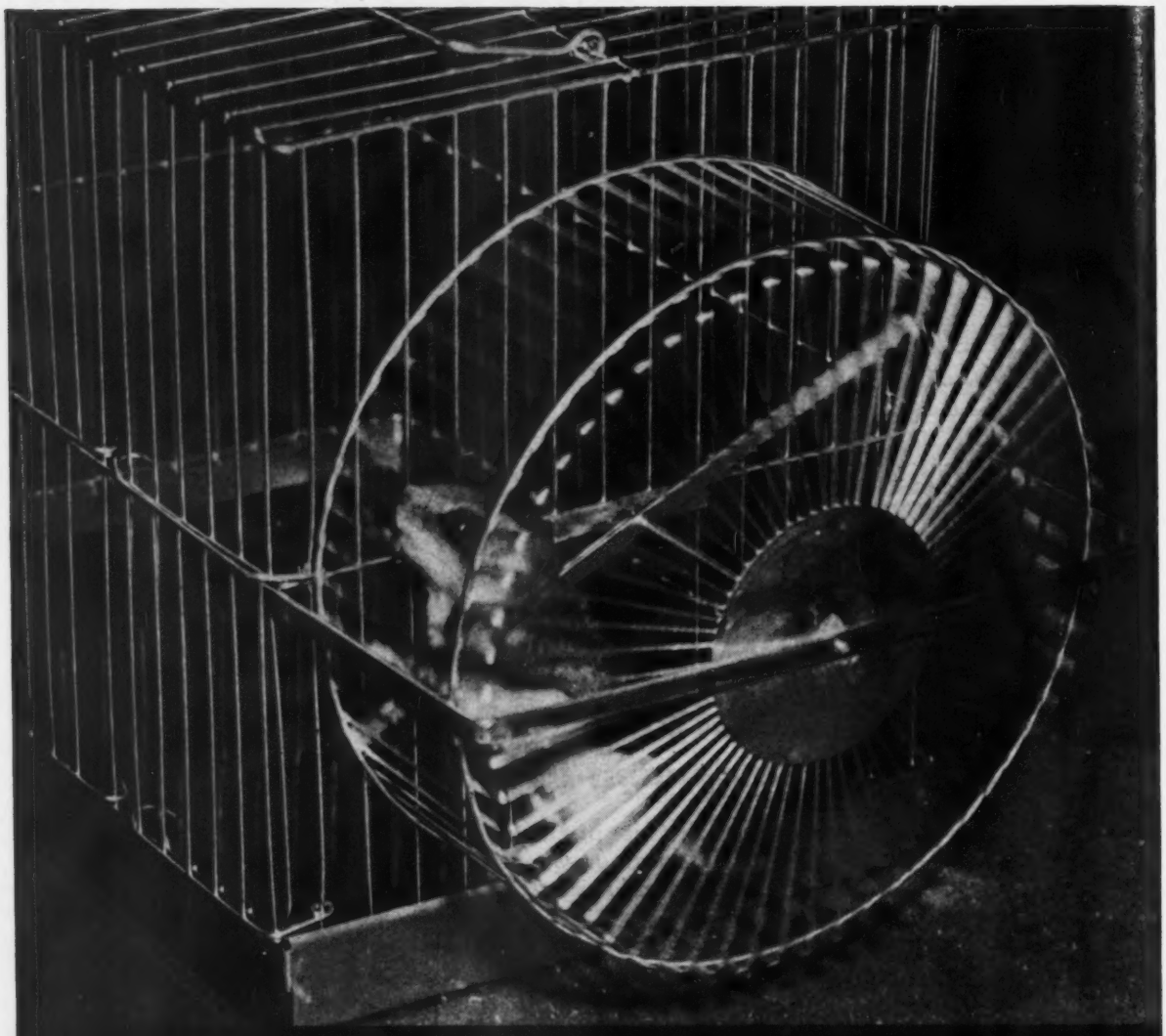

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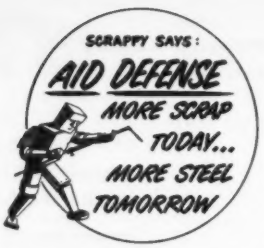

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UNITED STATES STEEL

WELDING methods ordinarily used with stainless steel won't always work with the super alloys. Automatic welders are one answer, such as this one in use for small parts fabrication at Solar Aircraft Co.

Subcontractors' guide to

FABRICATING with SUPER ALLOYS

By

J. W. WELTY

Assistant Director of Research

and

M. G. WEGEFORTH

Assistant Chief Production Engineer

Solar Aircraft Company

San Diego, Calif.

IN MACHINING super alloys, the grinding and preparation of cutting tools is 75% of the problem of fabrication in Solar's experience. It is highly desirable to have centralized grinding previous to drawing of the cutting tools. The operator should never be permitted to prepare his own tools.

Careful procedures should be established for a close control of all machining operations through instruction sheets as to proper feed rates and machine speeds.

Proper Tools for the Right Job

One of the difficulties of the precision manufacturer of jet engine components and their sub-assemblies is having the proper tool for the right job: not only suitable, but powerful enough. An engine lathe, for example, cannot be expected to do a job that demands a turret lathe.

While much heavy, specialized equipment that we and other major contractors have installed to cope with the problem may be beyond the scope of a subcontractor, it is well to take it into consideration when quoting on a job. Your customer will unquestionably check your facilities, and lack of equipment to handle, however good the intention, will be a definite deterrent to sub-contracts, particularly on super alloys.

Problems of machining are so complex that it is vital that the vendor secure proper information from his principal. Solar is pursuing a cooperative funneling of information to all of its sub-contractors, and the complexity of the undertaking can be seen in the fact that on one major jet assembly, fabricated of a standard 18-8, over 400 special pieces are sub-contracted out. Some of the typical difficulties that have been encountered are:

1. Failure of the vendor to set up his own program of correct feeds and proper preparation of cutting tools.
2. Full realization of the specifications and quality control demanded by the job.
3. Realization that many jobs are a part of a large development program being carried on by a major contractor in which details are under constant revision and correction. The vendor must realize the possibility of these changes in quoting on the job.
4. Personnel problems. With upped production quotas and new techniques required, a manufacturer may find that his tried and true personnel, his old time machinists, may buck these new methods which are not within their experience.

   At the same time he may dis cover that new and inexperienced personnel he may have to take on to cope with the job will learn quicker to do a new thing right, not having any preconceived notions.

   A considerable reindoctrination program may actually be necessary with his trained people. It can be worked out only with careful and diplomatic planning.

Are Tools Available?

One of the difficulties which affects major contractor and subcontractor alike is the fact that the machine tool industry, as a whole, is not producing the type of tools needed by these new jobs, nor tools heavy enough. Nevertheless, utilizing the experience gained

by others, the vendor may discover that with proper control, feed, speed, and cutting tools, he can actually achieve a higher rate of production.

He may, for example, be thinking in terms of 100 fpm when with proper tools and tool operation he may achieve 300 to 400 fpm. All of this information is usually available to him from the experience of his customer, and Solar maintains a considerable flow of such information to all subcontractors working on Solar jobs.

New Welding Methods

In fabrication with new super alloys everyone has had to learn by experience that methods that will successfully weld ordinary stainless steels are not necessarily applicable. Solar has maintained continuing development of automatic welding machines and techniques.

Techniques of correct heats and speeds and the study of protective gaseous atmospheres, as well as the use of the right type of filler rods have had to be developed. In resistance welding, for example, we have discovered that some metals are incompatible, will not spot-weld. In some cases it has been found that the insertion of a thin sandwich of unlike metal solves the problem since it offers welding compatibility with other metals in the assembly.

Processing Problems

Processing, including heat treating, annealing, descaling, and sand blasting of super alloys, again offers particular problems. Special furnace atmospheres may have to be determined to develop the right degree of scale that can be easily removed by subsequent pickling.

Metals are often coated with compounds to increase this scaling, deliberately yielding oxides we know we can get off. While the major portion of our descaling is accomplished by fused caustic operating at 700 deg. F., this is not normally available to smaller shop operations.

Acid pickling baths require careful adjustments and control, both in concentration and in temperature, if successful descaling operations are to result.

N-155, for Example

As a typical example of super alloy treatment which may be encountered in subcontractor fabrication, N-155 might be specifically considered. This Haynes Stellite metal is increasingly being used in turbine components, jet exhaust and afterburner parts. Formability of any particular shipment may be roughly evaluated by a simple bend test.

Annealing temperatures for this particular alloy are particularly high, at the level of 2,150 deg. F., time at heat being relatively short. As this temperature exceeds the capacity of many furnaces in smaller shops and the price of this class of materials is high (approximately five times that of stainless steel), it will be seen that the subcontractor is concerned costwise, both in basic availability of his facilities and in handling his materials. He must be more careful. Scrap metal is a decided cost factor.

Parts must be free of grease and foreign material before heat treating, since extraneous surface impurities bring danger of excessive carbon pick-up. If he is forming parts requiring interstage annealing, he should consider cost of farming out his processing as against installation of new equipment in bidding on this type of job.

N-155 should be rapidly cooled from annealing temperatures in order to produce maximum ductility and minimize danger of damage in the pickling tanks from carbide precipitation.

Testing and Machining

Parts should not be nested and should run in a reducing atmosphere, with plenty of free air around them. Lacking fused caustic baths, scale can be removed in a 10% nitric, 4% hydrofluoric plus water solution operated at approximately 150 deg. F.

This bath can serve a double purpose in that regular grades of stainless steels may be pickled in the same bath, though weldments should be watched carefully.

Welding characteristics of N-155 are good. It can be joined by a variety of standard procedures, such as gas, resistance, or arc welds.

Machining, however, may give trouble. The metal is tough, has fairly high strength and drills with difficulty. Sawing is also a problem. Band saws should be run in the range of 10,000 surface feet per minute. The saw actually melts rather than cuts the metal.

Know the Standards

N-155 is included solely as an example, but it is typical of problems encountered with a whole range of super alloys. With the principles of its handling understood, for example, we have been able to proceed to like handling of other alloys. The type of parts themselves and their application determine specific procedures.

For example, experience will have to dictate the number of operations required in annealing. The subcontractor should call for information from the principal at all times and thoroughly familiarize himself with the metal specifications involved and the standards he must work to.

Don't Spare the Paper

Paper work is vital. Don't keep it in your head. There will be many strangers in the house, both from the major contractor and possibly from the government. Adequate paperwork is vital at all points. Solar, for example, requires each operator to initial the traveler on every job so that any specific operation may be referenced at any subsequent point.

Perhaps few subcontractors may come into contact with the class of super alloys under discussion. Yet, as these alloys become increasingly critical in supply, material conserving substitutes are constantly being sought for parts which they may be expected to fabricate.

APPLICATION of standard resistance-welder to conveyor-line production of jet-engine parts at Solar Aircraft Co.

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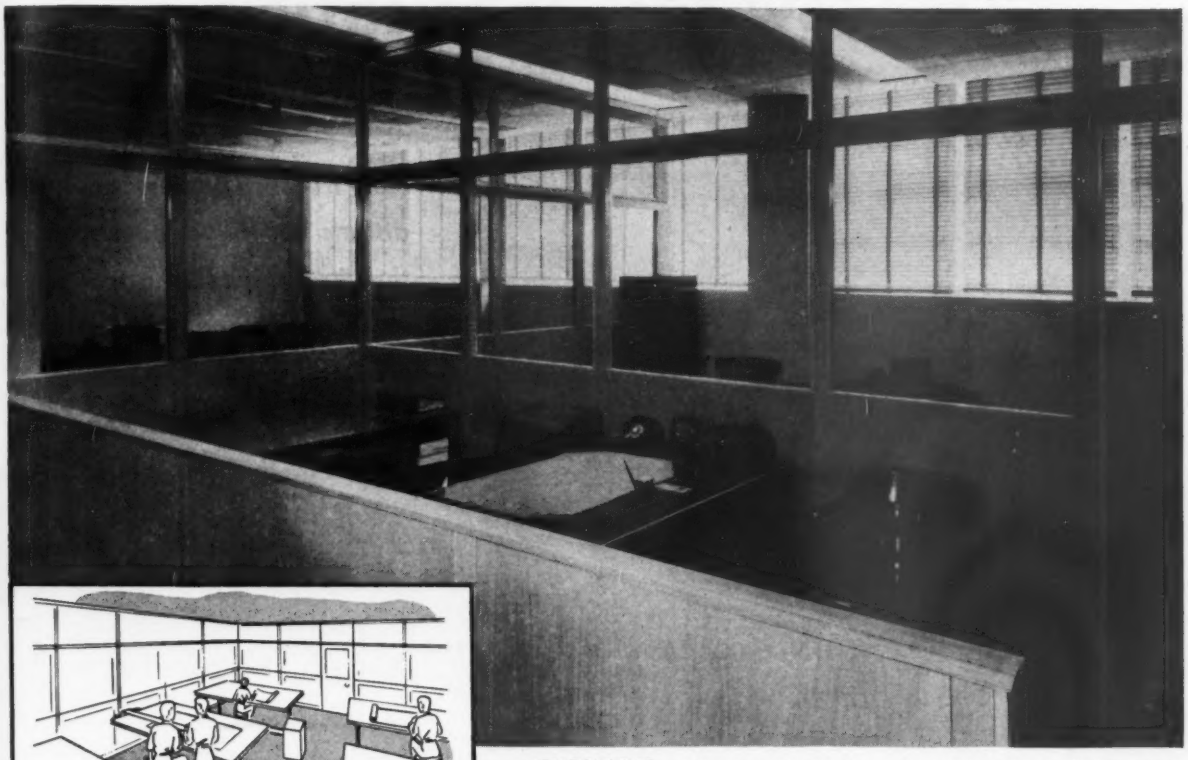

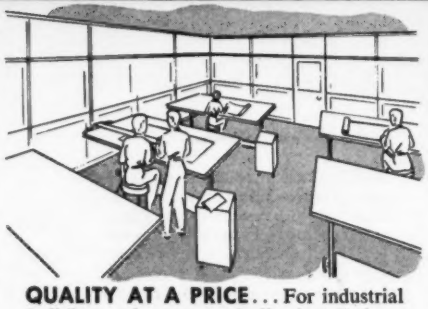

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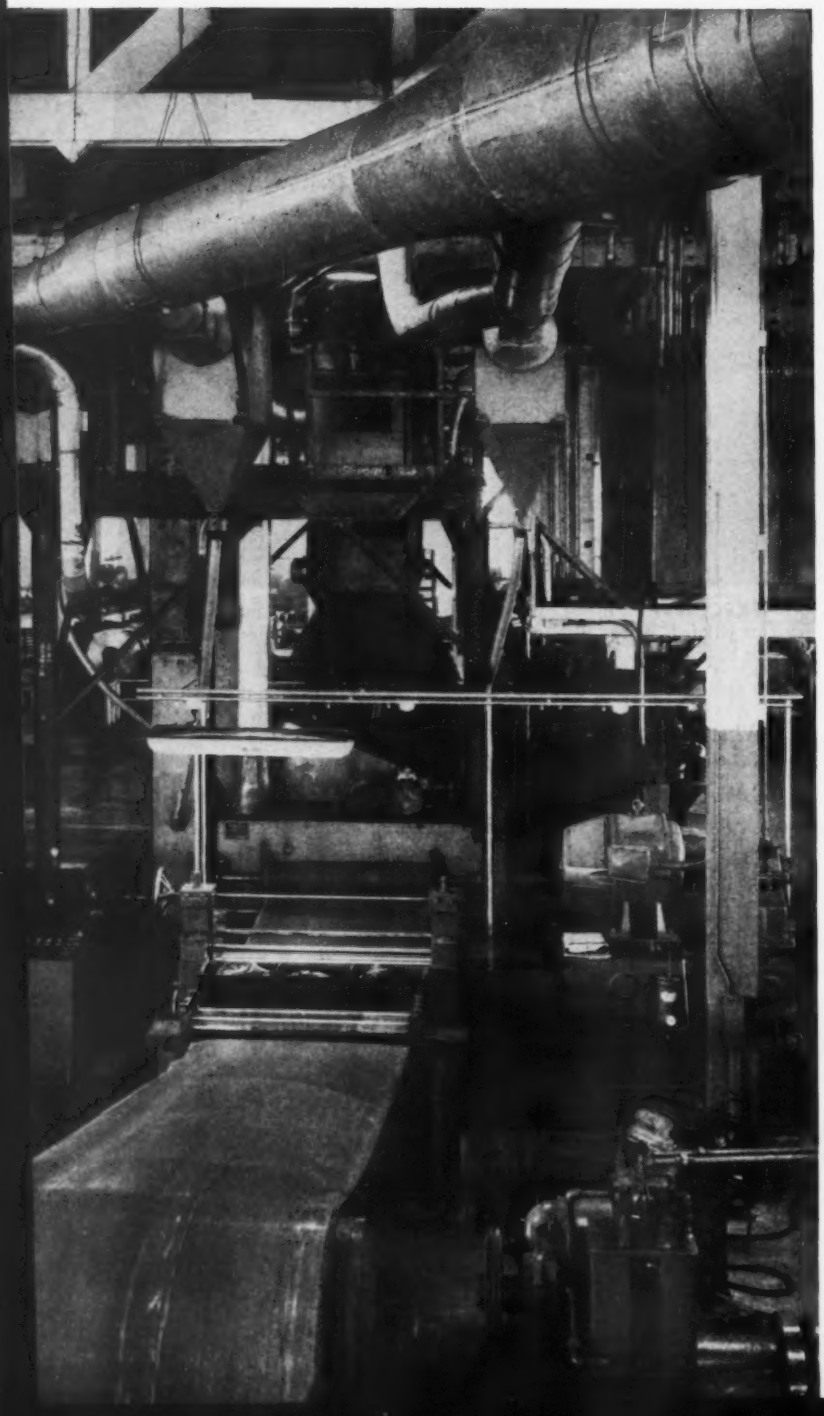


New treating process conditions hot rolled steel so that its fabrication qualities are similar to those of cold rolled. Plating and surface finishes take very well on the hot rolled metal

STRIP of 48 in. wide hot rolled sheet enters machine for shot blasting to remove surface impurities and prepare the metal for plating. Overhead ducts carry waste material removed by this treatment. Overhead hoppers hold steel shot used in the process.

CLEANED STEEL comes from the Wheelabrator at speeds up to 80 ft. per min. Normally, wide strip is sliced into narrower strips for bending into conduit. Steel is blasted by tiny shot at the rate of 1,000 per min., striking the sheet at rate of 15,000 ft. per min.

HOT ROLLED steel, generally considered much cheaper than its cold rolled brother, has often been disregarded as a usable material because it had an inherent surface scale that had to be removed (usually by acid pickling) before it could be fabricated into products that required surface finish, such as plating.

Advantages of Hot Rolled

But hot rolled steel now has two commercial advantages: (1) it is less expensive than cold rolled, and (2) it is in considerably better supply than cold rolled.

Rome Cable Corporation, manufacturers of electrical conduit, recognized the advantages but were faced with the problem of finding a means of removing the scale economically and efficiently, yet leaving a clean matte surface to which zinc casting would adhere. With cold rolled steel, there was no cleaning problem.

Installation of a pickling vat and its supplemental equipment for handling hot rolled steel would not only be costly and require a large portion of their plant area, but unless it was of large dimensions would not turn out cleaned steel at a rate fast enough for them to maintain their normal production.

Answer Found

After suitable investigation of available methods, Rome Cable Corporation decided that the answer to this problem might be shot blasting of the hot rolled steel in continuous strips at a speed that would permit the rest of the plant to maintain its usually high production.

End Product

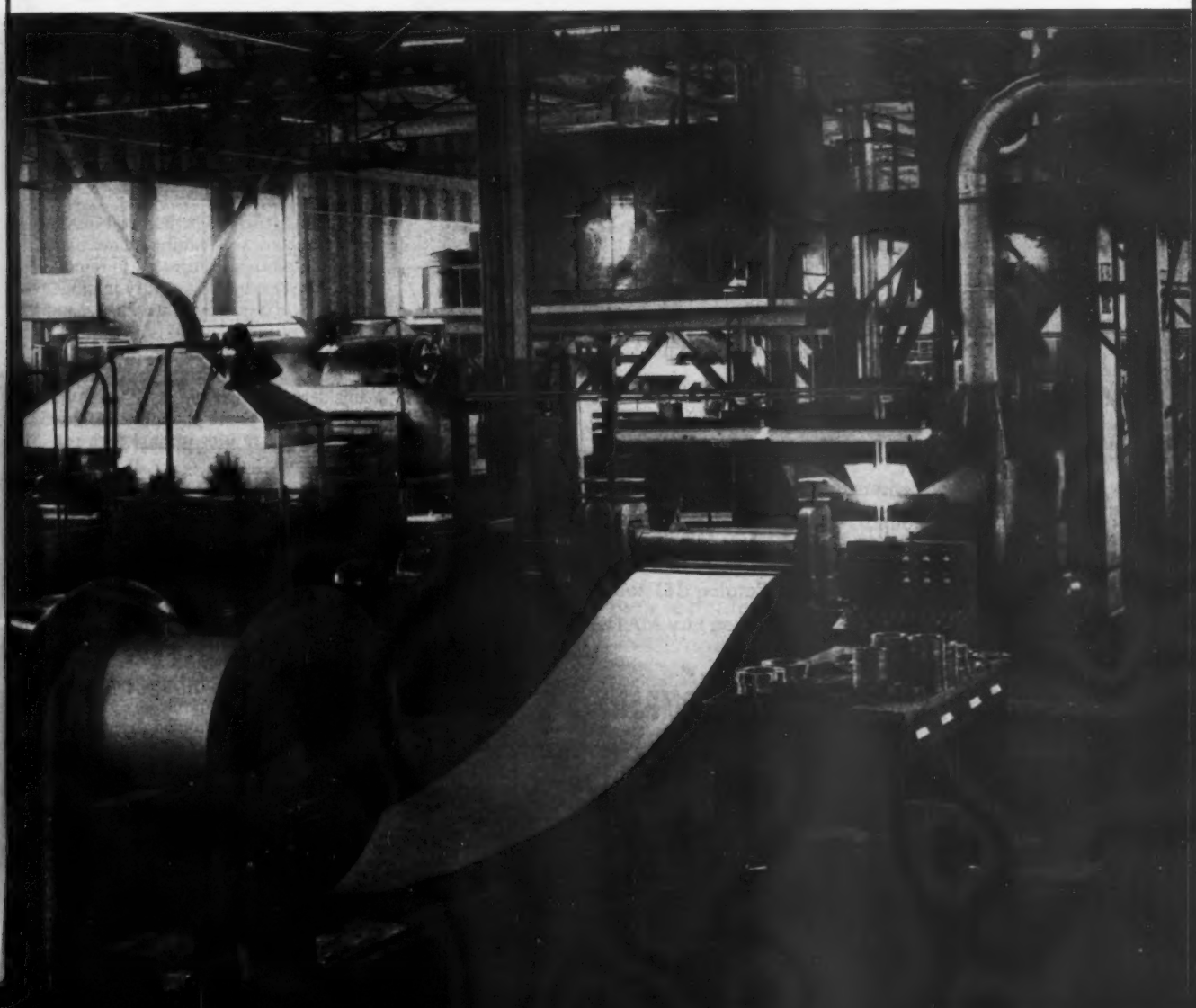
Electrical conduit is manufactured in diameters ranging from ½ in. to 2½ in., from steel strip delivered to the plant in 36, 40, and 48-in. wide rolls that weigh up to 12,000 lb. The wide rolls are "slit" into narrower strips, which are then fed through tube mills where they are formed into a tube and the joining edges welded.

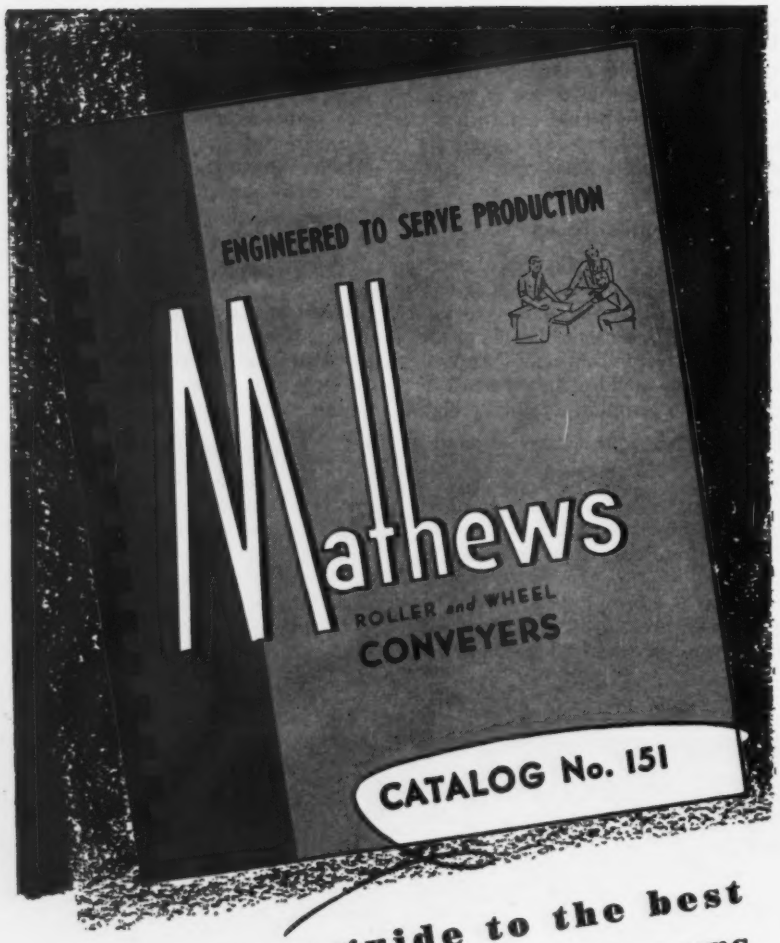
For shot blasting the wide steel strip, Rome Cable has installed a device manufactured by the American Wheelabrator and Equipment Corp., Mishawaka, Indiana. This piece of equipment carries out an airless mechanical cleaning of the metal by abrasive blasting.

What Does It?

Heart of the process is rapidly rotating bladed wheels that hurl abrasive by controlled centrifugal force against the strip as it passes through a closed cabinet. A combination of both volume and force of the shot do an effective surface cleaning job.

At the Torrance installation, four wheels are used to shot blast the steel strip. Each of the units hurls small spherical steel shot (about .025 in. in diameter) at the strips at a rate of 1,000 lb. per minute, with the shot striking the steel at a speed of around 15,000 ft. per minute. The





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wheels, 19½ in. in diameter and 5 in. thick, revolve at 2,250 rpm.

Wheels are staggered. Two of the wheels are set to hurl the pellets at the top of the strips, while the other two de-scale the bottom or underside. Staggering of the wheels permits cleaning of steel strip as narrow as 15 in. if desired.

Plant Operation

Large rolls of steel strip, varying from .109 to .154-in. gauge are loaded by fork lift trucks to a feeding reel. From the reel the strip is fed through a leveler which straightens it and feeds it to the Wheelabrator. Strip passes through the machine where it is descaled and cleaned at speeds up to 80 lineal feet per minute, then passes through the slitter which cuts it into the narrower widths.

Strips for the ½-in. tube are slit to a 2½-in. width. After slitting, the small strips are rewound and ready to be taken to the tube mills.

Plant Requirement

Requiring only 25 lineal feet of plant space (as compared to about 175 lin. ft. that would be required by an acid pickling installation), the blast cleaning process offers other advantages in that the simple action of stopping the wheels cuts off the cleaning action, whereas the cleaning action of the other method cannot be stopped at will.

Further, there is little metal loss in the mechanical cleaning. The blast cleaning process is adjusted to remove only the scale by the velocity impingement force of the round steel balls, and any loss of virgin metal is at a rate so small that it would be difficult to measure. Acid pickling is generally considered to eat up 1½% of the virgin metal. Small though this figure may appear, it adds up fast with production runs.

Cost Information

Cost of operating the Wheelabrator equipment is the basic cost of abrasive, maintenance labor, spare parts and power, and can be computed at a constant figure per wheel hour of operation. According to figures released by the American Wheelabrator and Equipment Corp., the per wheel cost per hour of operation is $2.73. Tonnage-wise, at the rate of production being obtained at the Rome Cable Corporation's Torrance plant, the Wheelabrator manufacturers estimate the cost for shot blasting the steel strip to be about 60 cents. This is about 30% to 40% less than pickling would cost.

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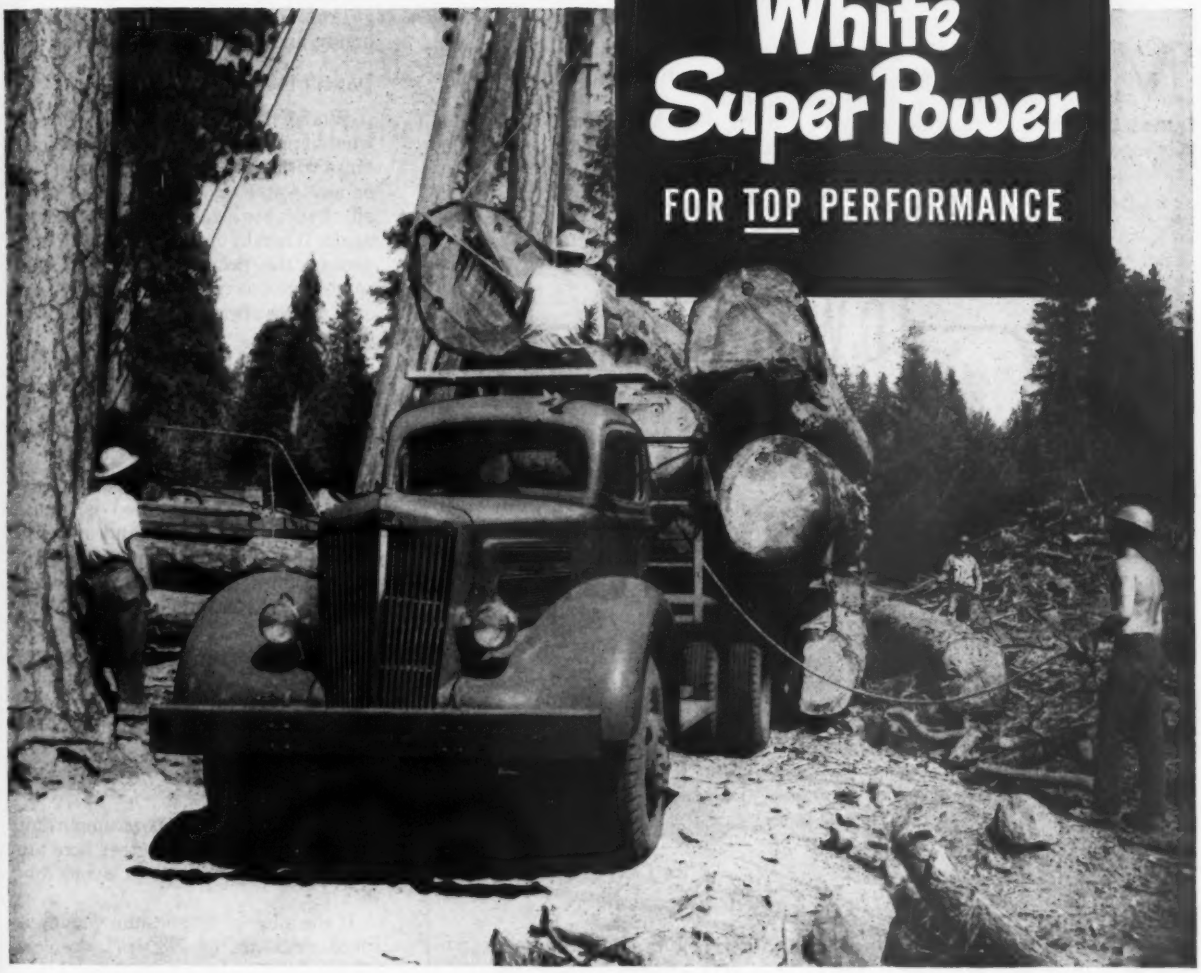

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SAFETY POINTERS for MAGNESIUM FABRICATORS

MAGNESIUM is no longer the mystery metal it used to be. It is now in quite common usage, but there are still quite a number of persons who do not entirely understand some of the properties of this metal—notably its behavior during fabrication, and some of the precautions to be taken to avoid fire. According to Magnesium Company of America, here are some of the high points:

Properly and intelligently handled, magnesium presents no more of a problem than any other metal. Under the right set of circumstances (which of course should not occur) it will burn, though, and fire-fighting must be taught to persons supervising and working with magnesium fabrication.

Proper equipment should always be handy and ready for immediate use.

Doesn't like water

When magnesium burns, this is what happens: the burning metal combines with water (dampness in the air or any water on the spot) and gives off hydrogen gas and magnesium oxide. When hydrogen mixes with oxygen in the proper proportion, that combination is very explosive. Oxygen, of course, is always present in quantity in the air.

Knowing this behavior of magnesium, it is easy to see why the burning metal should NEVER be fought with water. An explosion may result.

Smother it

Best firefighting method is to use powders, fluxes, or dry sand and dry, clean iron filings. Main principle in fighting magnesium fire is to smother the burning area so as to exclude any possible supply of air.

Burning magnesium does not generate toxic fumes; so it is perfectly safe to go into the area with the burning metal in an effort to extinguish the fire.

Prevention best

Prevention is far more important and inexpensive than regret: here are some pointers on how to avoid any disaster.

If the alloy of magnesium is a minimum thickness of .080 in., there is relatively little danger from fire. Magnesium alloys are safe for use as housings of portable electric appliances under ordinary conditions, according to a report issued by Underwriter's Laboratories.

Trouble in sand casting

In die casting and permanent mold casting, use of magnesium is relatively safe since the conditions that support combustion will probably not exist. However, in sand casting operations, it is a different set of conditions.

Usually, the molds consist of 3-5% moisture. When the hot metal is introduced, that moisture turns into steam. Hot magnesium will decompose the steam into hydrogen and oxygen and an explosive mixture is present to give you plenty of trouble.

Remedy: addition of inhibitors to

Concluded on page 70

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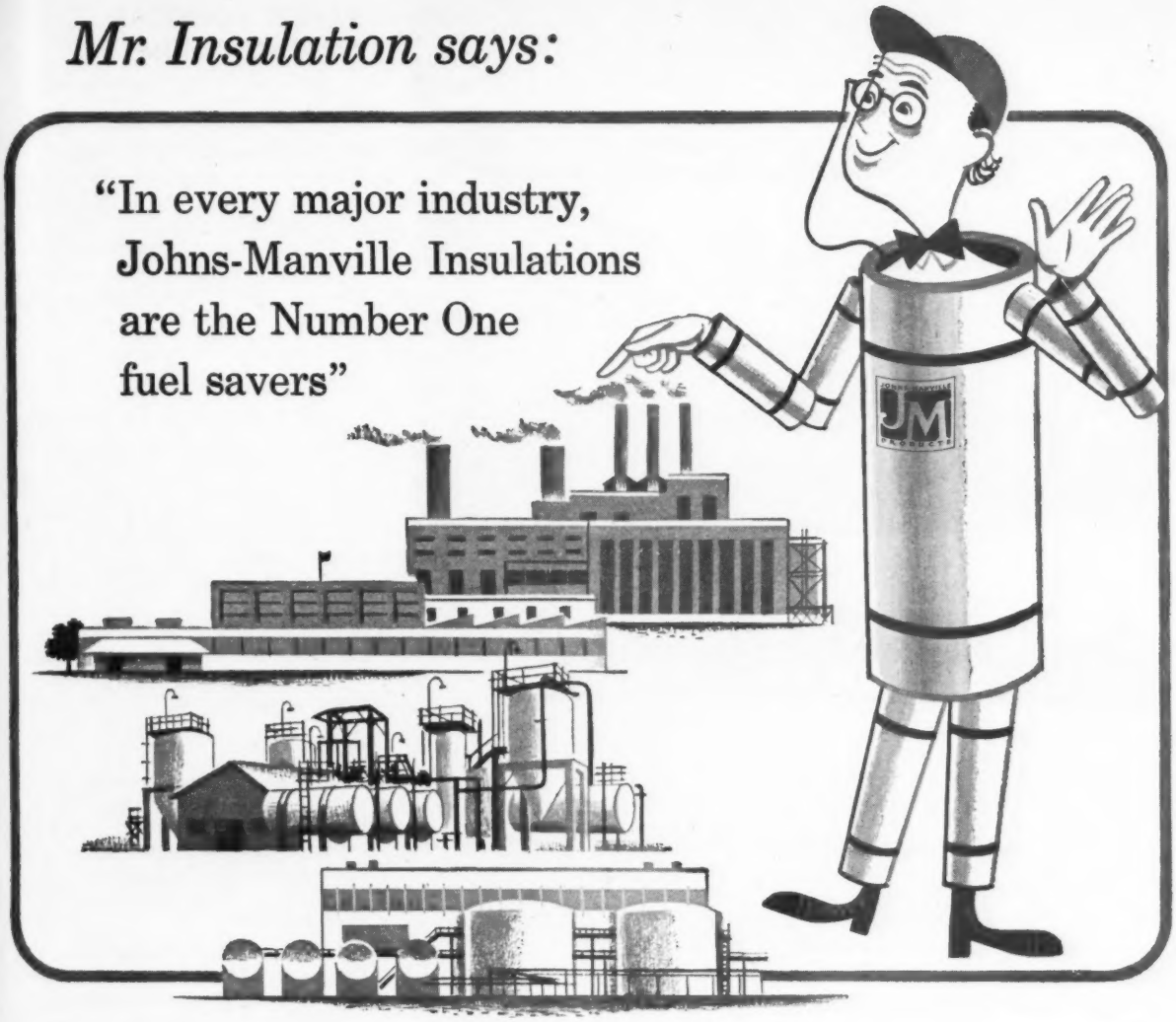

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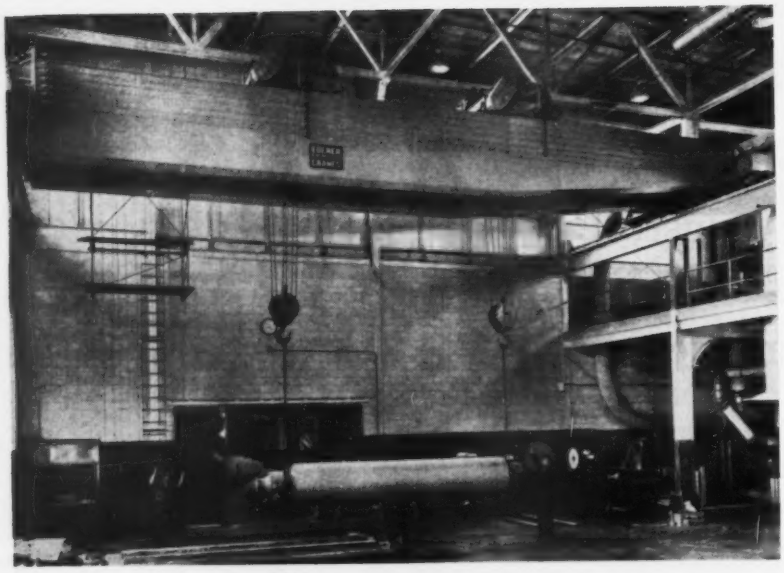

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SAFETY POINTERS for MAGNESIUM

. . . begins on page 68

the molding and core sand mixtures. Such inhibitors are usually ammonium fluoride, boric acid and sulphur. Diethylene glycol is used to replace part of the water.

To prevent rapid oxidation or burning of the surfaces of sprues and risers that are exposed to the air, sprinkle them with sulphur flour to exclude the air.

Grinding dangers

Very fine particles of magnesium dust can cause trouble by fire just like dust in a grain bin, or coal dust, or flour dust. Of all the metalworking processes that produce magnesium dust, grinding is perhaps the most liable. Therefore, care must be taken to collect magnesium dust particles in water, and clean the collectors every day. If the proper wet collection system is not available, the only safe way to grind magnesium is to grind it in water, or wet.

Use sharp tools

In machining of magnesium, the safest method is with sharp tools and heavy cuts. No water solution or water cutting compound can be used. If coolant is necessary, oil should be used.

Keep area clean

Areas in which magnesium chips are produced must be kept clean every day. Smoking in those areas should be prohibited. Chips should be put in metal drums and kept covered. Fine particles and dust should be disposed of as soon as a drum is filled. Burn the fine particles in a controlled fire, and bury the wet dust—or dry it in a magnesium fire and burn it up.

Dust-proof clothing

Clothing of persons who work with magnesium should be of material that is safe (i.e., designed so that dust will not stick to it, so that dust will not penetrate into it, and so that dust cannot collect in cuffs or pockets).

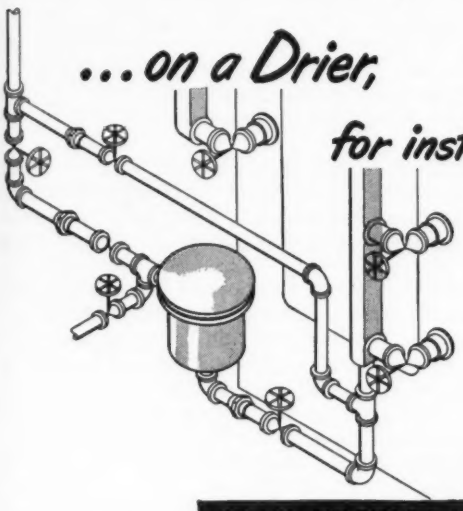
Caps should be worn so that magnesium dust will not collect in your hair. Clothing should be cleaned often. Above all, clothing should be designed so that it can be taken off in a hurry.

Be sure

Summary: magnesium dust plus air or oxygen plus humidity plus heat spells trouble in the form of fire or explosion. Magnesium dust collected under water is safe, since the heat factor is eliminated.

Example of Steam Trap Durability

...on a Drier, for instance



THE INSTALLATION

On heavy-duty, steam-heated tumbler-type drier at American Linen Supply Company, Cincinnati.

THE HISTORY

A high discharge capacity trap was needed to operate this drier 16 hours daily under heavy loads, with 125 psi. steam. Specifications called for rapid, fully automatic condensate removal to insure fast warm-ups and a steady flow of hot, dry steam to the drier. Naturally, the lowest possible trap maintenance cost was also wanted.

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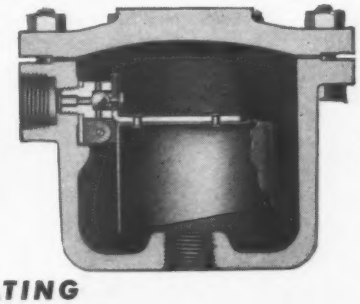

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rivets or welding

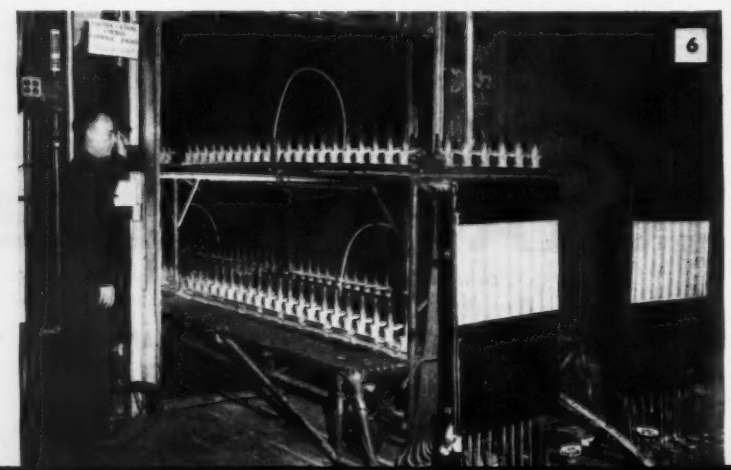
ONE OF THE MOST difficult problems encountered by Consolidated Vultee engineers in the design of the giant B-36, world's largest bomber, was the development of a light weight trailing edge which would withstand severe vibrations. Under the constant drumming of the 3500-hp. pusher engines, conventional riveted ribs and skin assemblies showed signs of metal fatigue. Spotwelding yielded the same results.

Out of this need for a superior bonding agent was developed "Metlbond." Evolving through a series of developmental phases, Metlbond offers a fast, sure and relatively inexpensive method of "glueing" metals. Beginning with its application in fabricating trailing edges, the use of Metlbond in the B-36 has been expanded to include about one-third of the exterior surfaces, as well as the assembly of sandwich parts such as tables, flooring and partitions which are composed of metal or fiberglas faces and light cellular cores.

Unlike the common variety of adhesive, Metlbond provides a chemical rather than a mechanical bond. In Metlbond an actual union of molecules of the resin with those of the metal is achieved. Smooth surfaces, therefore, provide better bonds, since small projections tend to interrupt the continuity of the bond, reducing its strength.

Manufacturer, under license of the Convair originated Metlbond is Narmco, Inc., Costa Mesa, California. Answers to questions about prices, detailed application methods, performance data and adapability to non-aircraft production processes can be obtained from Narmco.

1. **Contact area is first wiped clean with a solution of naphtha to remove all traces of oils, grease and soils.**
2. **In the spray booth two coats of Metlbond cement are applied. Work travels on continuous circular track through the process.**
3. **Metlbond tape is cut to length and applied to contact surfaces. Different width tapes are available as required.**
4. **With tape also applied to skin surface, stiffeners are spotted accurately with metal locating fixture.**
5. **Rubber blanket, secured at edges, is drawn over batch to be cooked. Then air is evacuated before insertion into the oven.**
6. **After cooking 25 to 35 min. at 320 to 340 deg., the batch is removed and cooled at room temperature.**



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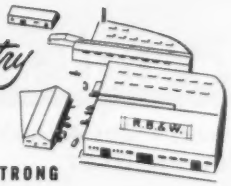

WEST COAST PLANT: 4466 Worth St., Los Angeles, Calif. Other plants at: Port Chester, N. Y., Coraopolis, Pa., Rock Falls, Ill. Additional sales offices at: Oakland, Dallas, Chicago, Detroit, Philadelphia. Sales agents at: Portland, Seattle. Distributors from coast to coast.

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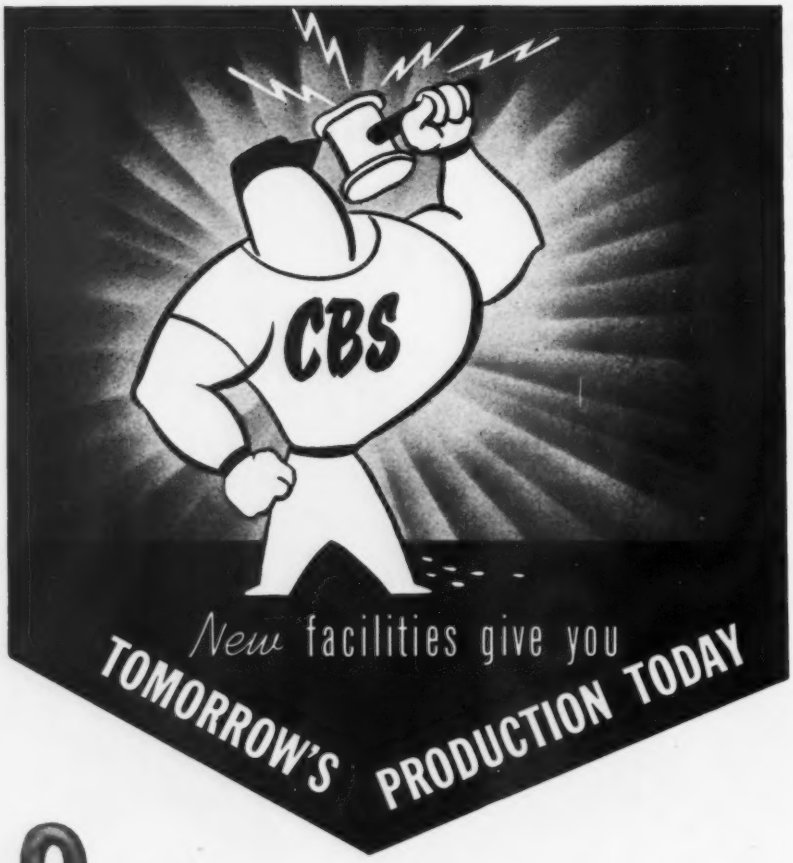
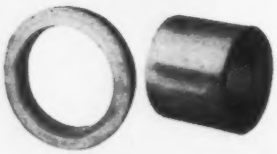


.....flat die forgings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The Nation's Fastest Growing Tooling Center

FASTEST GROWING AREA in the United States for the manufacture of special tools and dies needed in the mass production of defense items, according to the National Tool and Die Manufacturers Association, is now Los Angeles.

A fantastic number of shops has sprung up in the area in recent months. More new plants and facilities are being added as rapidly as men and machines can be found. Sales during the past year have doubled. There now exists a three-month backlog for orders. Of necessity some of this volume must be diverted to the Middle West and East Coast.

Orders being placed by West Coast defense industries for jet aircraft, guided missiles and electronics instruments have resulted in contract tool and die shop expansion in Southern California which surpasses even that of large tooling centers such as Detroit, Chicago, Cleveland and Dayton.

To compensate for the shortage of skilled men, the most productive machine tools will be needed, according to George S. Eaton, executive secretary of the Association. It is estimated that an additional 2,000 toolmakers are needed in the Los Angeles area alone.

This figure reflects the seriousness of the labor shortage because of the fact that one skilled tool and die maker can set in motion as many as 30 mass production workers.

NTDMA, composed of more than 500 contract tool and die shops throughout the country, held its national meeting in Los Angeles in February.

Officers of Southern California chapter are: President, Carl T. Weitzel, Mechanical Specialties; vice president, John Gibson, Modern Tooling Co.; treasurer, Mike Alu, Falco Co.; secretary, Russ Lamb, Tool-Matic Co.; and NTDMA trustee from Los Angeles, James Riddle, Modern Tooling Co.

Steel Statistics . . .

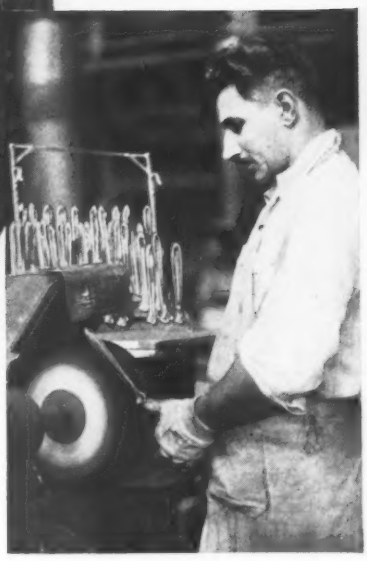
COLD FINISHED BARS

As of January 1951
Source: American Iron & Steel Institute

COMPANIES	ANNUAL CAPACITY (Net Tons)
Pacific Tube Company	12,000
Sierra Drawn Steel Company	21,600
Republic Steel Corp.	18,000
STATE	
California	51,600

ANOTHER CUSTOMER CONVINCED:

Formbrite cuts polishing time in half



Mirror handle sections are formed on a 400-pound drop hammer from blanks measuring 1⅝" x 8" x .032". Trimmed and soldered, the completed Formbrite handle requires only a light "color buffing" operation—accomplished in half the time previously required for ordinary drawing brass. Handle is soldered to etched mirror back and lacquered to retain its lustrous finish.

ASTORLOID Manufacturing Co., Inc., Bronx, New York, makers of dresser sets and cosmetic containers, asked us point blank: "Just what *is* Formbrite*... and what will it do for us?" We explained that Formbrite is specially processed forming brass with such an exceptionally fine grain that buffing time is substantially reduced. It is stronger, "springier" and has a harder, more scratch-resistant surface than ordinary brass, yet is so ductile that it can be readily formed or drawn. Besides, it doesn't cost any more.

Astorloid's production engineers made a trial run of Formbrite in red brass alloy in their own press and polishing rooms and were amazed at the sharpness of the die impression ...and at the bright lustrous finish which was obtained by a simple "color buffing" operation in half the time previously required.

Millions of pounds of Formbrite sheet, strip, rod and wire have been produced and satisfactorily fabricated into a wide range of products. We'd like to tell you more about the time and money-saving possibilities of this fine-grain metal... and send you a sample to try on your own polishing wheels. Address The American Brass Company, General Offices, Waterbury 20, Connecticut. 5286

*Reg. U. S. Pat. Off.

Formbrite Drawing Brass is an

ANACONDA

PRODUCT

made by THE AMERICAN BRASS COMPANY

SOMEBODY pays for the scrap!

These screw machine parts, illustrated full size, are typical of the gas conversion appliances produced by Anderson & Forrester. Note the wide range of secondary machining operations necessary, such as slotting, milling and cross drilling. Some orifices require a No. 80 drill (.0135").

... and by scrap we don't mean the rod ends and chips incidental to screw machine operations – we mean the machined parts that, for one reason or another, wind up in the scrap bins instead of the shipping department. No one can speak with more authority than Anderson & Forrester, Denver, Colorado, manufacturers of gas jets, orifice caps, plugs, pilots and similar natural gas conversion appliances:

"We've been in business 25 years. We make hundreds of different screw machine products – millions of units a year – using over a million pounds of Anaconda Free Cutting Rods. We like these rods because we've always found them to be uniform in temper, dimension, machinability and over-all quality. Recently it was necessary to substitute some rods of a different make. Our operators spotted the difference immediately, complaining of 'hard temper,' excessive scrap and tool wear.

"We don't like to pay for scrap, nor can we pass along the cost to our customers. We depend on Anaconda Rods for the uniformity that gives us maximum tool life and permits us to duplicate standing records of speeds and feeds for long, uninterrupted production runs."

There are 46 Anaconda Copper and Copper Alloy Rods in a wide variety of commercial sizes and shapes suitable for screw machine use. Nineteen are free cutting alloys. Write for a copy of Publications B-14 and B-3, addressing The American Brass Company, General Offices, Waterbury 20, Connecticut.

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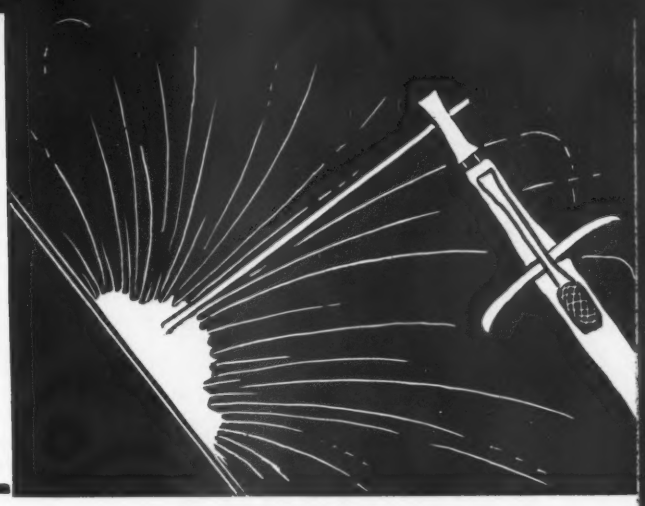
for top screw machine production

WELDING



How to make

YOUR SPOT WELDING MACHINE

do some "impossible" jobs

By
J. R. FULLERTON
Spot Welding Engineer
Ryan Aeronautical Corporation
San Diego, Calif.

SINCE SPOT WELDING was first developed, aircraft designers have wanted to use this fast, clean method of fabrication for aircraft structures. However, it was not possible to employ spot welding in primary, load-carrying structures for aircraft until comparatively recently because the process was not thoroughly reliable for continuous production line use.

This was due to the characteristics of the welding machines, which made them somewhat unpredictable. Spot

TWIN spot welding guns used on Ryan production lines at Ryan, are suspended from overhead monorails, can be moved up and down assembly lines.

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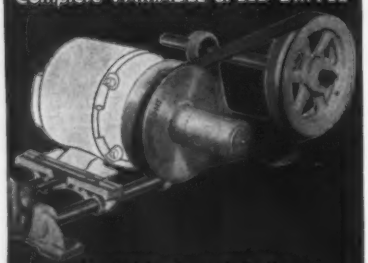

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welding differs from fusion welding in that the joining is accomplished in metal within the plastic temperature range—that is, below the melting point of the materials being joined. Heavy currents generate heat sufficient to render the work plastic enough to permit it to be squeezed together and forged under pressure. Invisible nuggets of cast metal are thereby formed between the sheets of material.

Here's the Formula

Nugget size is a function of the heat developed. Heat developed is controlled by the electrical resistance of the joint multiplied by the current squared multiplied by the time or current flow multiplied by the coefficient of thermal conductivity of the material. Joint resistance is definitely influenced by the type of material, surface condition of the material, pressure exerted and size of the electrodes.

All of these factors have an important effect upon the results obtained from the spot welding process. Until the advent of the electronic tube control, such as we now have, it was not possible to control these conditions within the margins required for joints of high integrity. Spot welding was used for secondary components such as fire wall diaphragms and cowls and fairings because these structures were not required to carry important loads.

Efficiency Comparison

Now, with modern spot welding machines, primary load-carrying structures can be produced with uniformly strong joints. Ryan is securing spot welded joints that are 100% efficient as compared with an average of 60% efficiency for riveted joints.

Typical examples of components built in volume with spot welding are the 49 floor beams which Ryan builds

KEYS TO IMPROVED WELDING PERFORMANCE

WITH THE NEW electronic controls now available for controlling such machines, a wide variety of performances can be obtained from a specific design.

However, the most important factor in the obtaining of good production from spot welding is the selection of the equipment. This is paramount to all other considerations.

With modern controls, machines can be set to provide slope control, tailing heat control, pre- and post-heating control, half-cycle firing and plus or minus cycle firing.

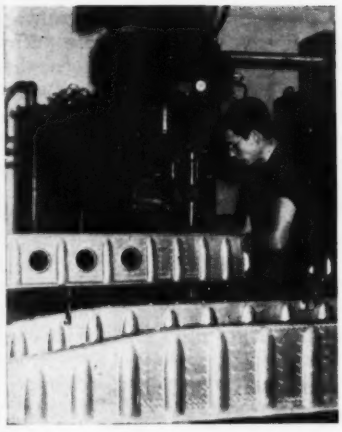
SLOPE CONTROL: In which the already brief period, during which the "firing" of the welding current occurs, is further regulated so that the inrush of current is momentarily dammed and then allowed to build up in a crescendo. By this split-second restraint, added time is provided to permit the welding heat to be better absorbed by the metal surrounding the spot weld. This avoids the "splash," or explosion of hot metal from too sudden heating. With slope control, it is possible to place larger spot welds in smaller areas and to place them very close to outer edges—giving designers greater latitude.

TAILING HEAT CONTROL: This refinement is a controlled diminution of current amplitude after welding to obtain a retarded cooling of the metal and prevent shrinkage cracks. Particularly valuable in the fabrication of aluminum alloys, which tend to cool quickly, this innovation allows the current to "die down" gradually in a few hundredths of a second.

PRE-HEATING AND POST-HEATING CONTROL: By arranging for a reduced heating current, immediately prior to welding current, it is feasible to pre-heat thick-gauge metals and allow the electrodes to seat better and also permit the spot welding of these heavy materials with lower currents. Post-heating technique is employed to temper spot welds ingeniously in heat-treatable steels without recourse to time-consuming furnace procedures. This precise control of the current after welding is designed to cause sudden cooling, to "quench" the metal, and then a reduced heating is applied to "draw," or temper the spot welds and give them added strength.

HALF-CYCLE FIRING: With the new electronic controls, Ryan engineers can harness fractional cycles from the three-phase, 60-cycle line current in the plant. By timing the firing of the welders to occur on half-cycles, extremely short heating currents can be planned. These fractional firings are useful for spot-welding thin-gauge aluminum alloys which require high-current, short-time values.

PLUS OR MINUS CYCLE FIRING: Ryan engineers have gleaned another advantage, which the new controls make possible, in this technique. By tapping the welding current wave on alternate plus or minus cycles, a unidirectional spot weld can be made which is uniformly off-center. In welding sheets of different thicknesses, this dislocation can be designed to occur so that the spot welds are cast deeper in the thicker sheet, to maintain uniformly strong adherence.



1,000 spot welds are precisely located in each of these Boeing C-97 floor beams.

for every Boeing C-97 Stratofreighter. These beams carry the 68,000 pounds of cargo which the big Stratofreighter can haul for the Air Force. They are light-weight aluminum alloy structures which are fabricated with more than 1,000 spot welds per beam.

Modern Techniques

Another interesting assembly, made possible by modern spot welding technique, is the huge external wing tank which Ryan is currently building in large quantity. This mammoth container, largest external fuel tank ever produced, was designed for spot welding from its inception. Its entire outer surface is spot and seam welded. It is absolutely gas-tight in all joints and seams by means of welding alone, without the use of any sealing compounds. Each joint is formed with two rows of spot welding and one row of seam welding.

Spot welding is used generously in fabricating stainless steel jet engine parts and exhaust system manifolds for conventional aircraft engines. Important fittings, brackets, doublers, flanges and hangers are spot welded on the Pratt and Whitney exhaust systems which Ryan builds for the R-4360 power plant—a 3,500-hp. piston engine serving Boeing Stratocruiser aircraft and installed in the famous Convair B-36 Intercontinental bombers. In the manufacture of the combustion chambers, transition liners, tail-pipes, exhaust cones and afterburners for General Electric J-47 jet engines, spot welding performs most of the joining tasks.

Ideas Start in the Shop

Ryan spot welding engineers and metallurgists have had a pronounced influence upon the design of the country's most modern and largest spot welding machines. Ryan has worked very closely with these manufacturers to specify exactly what was required for the work involved. This is an important factor because practically all large machines are now being designed for particular types of work due to the exacting nature of aircraft welding.

For instance, in projecting the production of the big fuel tanks, Ryan engineers and spot welding experts worked together on the basic designs of the structure and with Federal engineers to obtain machines large and powerful enough to do this specific job.

As a result, Ryan installed four sets of machines, each set consisting of a seam welder and spot welder, which are the largest of their type. Several of these machines will fire 120,000 amperes across a short circuit and can exert 11,300 pounds of pressure between their electrodes.

They have record-breaking throat depths of 60 in., and the electrodes are located 62 in. from the floor. They were designed to stitch quarter-inch thick sheets of stainless steel together and eighth-inch thicknesses of aluminum alloy.

One of the important requisites that Ryan spot weld engineers have specified for all machines, which are destined for use with aluminum alloys, is

UNIT RIG AND EQUIPMENT COMPANY

PLANT REPORT

FROM: ENGINEERING DEPARTMENT

TO: MANAGEMENT

SUBJECT: OIL FOG LUBRICATION OF THE AIR CLUTCH SYSTEM ON THE UNIT RIG DRAW WORKS

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To help reduce costly shutdowns of oil rigs on which our Draw Works are used, by assuring maximum length of service of our equipment.

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One important solution was improving the lubrication of our air clutch system, by using Norgren Oil Fog Lubrication: 3 to 8 lubricators per machine with ½ pint to 1¾ gallon oil reservoirs; lubricating parts up to 30 ft. from the Lubricator, through ¼", ½", ¾" and 1" lines. Air flow is for approximately 2 seconds at varying intervals, with flow rate of 3 cfm; applied air pressure 125 psi.

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deflection firing. This is an added feature which guarantees precision firing and is most important when welding aluminum because the electrical resistance of these alloys is low and their surface condition affects spot welding results most critically.

Rapid Spot Welding

Deflection firing is required by Ryan because errors can easily occur with standard machines without this accessory. The machine's air pressure gauge, which registers air pressure fed to the electrode ram, is located some distance from the cylinder. While it measures the line pressure, it does not accurately indicate the electrode pressure. This is especially true in rapid spot welding sequence because the machine cannot handle the volumes of air in the cylinder fast enough to guarantee exact pressure on the electrodes for the split second period when the current is fired.

Deflection firing overcomes this deficiency by the installation of a deflection member in the electrode assembly. This member actuates a microswitch which can be set by a micrometer screw to operate at a predetermined deflection.

By plotting the characteristic deflections of each machine, a series of curves can be obtained which shows the exact settings for obtaining precise pressures.

For example, a certain job may require an electrode pressure of 4,000 pounds. From the deflection curves, it may be indicated that this pressure can be obtained from the specific machine by setting the deflection microswitch to fire at .040 in. Then, that machine will fire its current for every spot weld at the exact deflection of the electrode that has been set, giving an exact electrode pressure before the current is released.

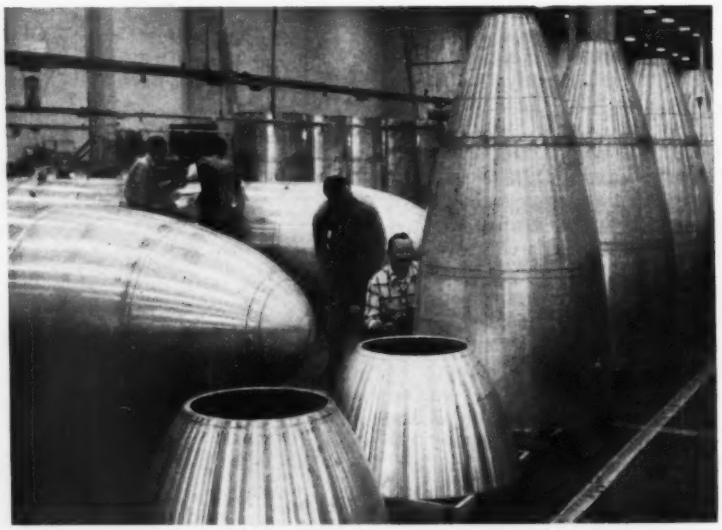
This is extremely important because the coordination of these two factors determines the formation of the cast nugget and its strength. Without deflection firing, the machine must be set by the air pressure gauge, which cannot be precisely correlated to electrode pressures under varying speeds of production.

High Standards

Quality standards are so high today for aircraft structures that are spot welded, that good spot welding machines should be designed with the type of work in mind and also with a sufficient margin of capacity to make the continuous production of this work possible.

This is especially important in transformer design because the transformer, which converts the line currents to the high amperage necessary for spot welding, limits the machine capacity. Most standard three-phase machines are equipped with transformers which will provide low frequencies of (20), (12), (8-4/7), (6-2/3), and (5-5/11) cycles. These variations are required to provide effective weld time variation for heating different thicknesses of materials.

Control panels should also provide



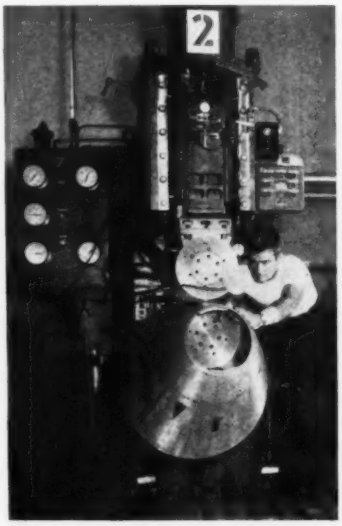
LIKE SECTIONS of a big torpedo, these fuel tank sections are completely seam-welded into one continuous, smooth surface. Exterior of these tanks has no rivets to mar its aerodynamic cleanness. Photo shows final assembly at Ryan.

effective phase shift heat control, adequate electrode pressure ranges and the various refinements of control mentioned previously.

Ryan's big welding machines are designed for the necessary accessories which converts them from spot welders, to seam welders and roll spot welders. To convert the spot welding machines to seam welding, which is the production of a series of overlapping spot welds, it is only necessary to add one unit to the control panel, change the electrodes to wheel type and install a drive mechanism for feeding the work.

To convert to roll spot welding, another control panel unit is added, which is simply done, and the drive mechanism is regulated for intermittent operation. Roll spot welding is accomplished with wheel electrodes and involves the rapid production of spot welds at spaced intervals along continuous seams. It is especially useful where exact spacings and rapid work are required.

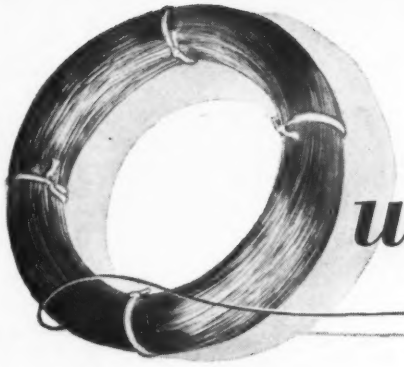
Three of Ryan's big machines are universal types which can perform longitudinal seam welding, with the



THIS FUEL TANK nose section is being seam welded in electrode wheels of the unusually large machine.

wheel electrodes installed perpendicular to the machine instead of parallel to it. This set-up is employed when seam welding a closed cylinder along its longitudinal seam and is easily adapted to Ryan's modern equipment.

With more than 70 electric resistance welding machines in operation in the San Diego plant, Ryan has the most modern and largest capacity facilities for all types of resistance welding, in the aircraft industry.



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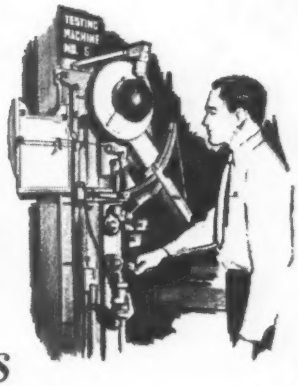

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BLOCKS OF STEEL of .20-.30 per cent carbon and 7 by 8¼ by 7 inches were used to test metal cutting efficiency of Arcair Torch as compared to conventional chipping method. Time saved by Arcair process amounted to 79 minutes, or 75 per cent.

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BY DEFINITION, the Arcair process is a means of removing metal by applying controlled heat (from an ordinary electric welding machine) and air under pressure. No gas cylinders or regulator valves are necessary.

This process offers valuable savings to industry from many of its uses. It is of particular value in non-ferrous gouging and cast iron gouging, where it is reported to do the job cheaper and better than by other means.

How It Works

Simply explained, it works like this: An ordinary electric welding machine (300 to 400 amps DC) is used, but with a carbon electrode instead of a welding rod. The work itself forms the ground side of the circuit.

A jet of compressed air blows alongside and parallel to the carbon electrode. This air stream has two functions: (1) it concentrates the heat at

REMOVING padding heads, one of many applications for the Arcair process

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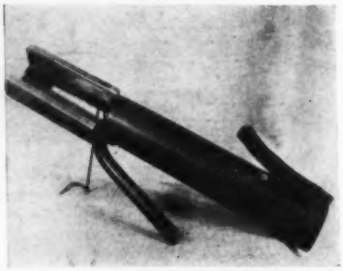
the torch tip, where the heat is wanted, and (2) it blows away the molten metal, much the same as an oxy-acetylene torch does. Otherwise, the metal would merely melt and drip.

Best operating pressure at National Supply Co., Torrance, California, has been determined at between 80 and 90 lb.

What It Is

Hubert Chappie, Foundry Superintendent at National Supply, describes the Arcair torch as being compact (10¼ in. long), and containing an air control valve and rotating nozzle (which permits changing the electrode angle to suit the job at hand, while maintaining the air jet in perfect alignment).



HERE IT IS—a compact gouging and cutting torch, only 10¼ in. long.

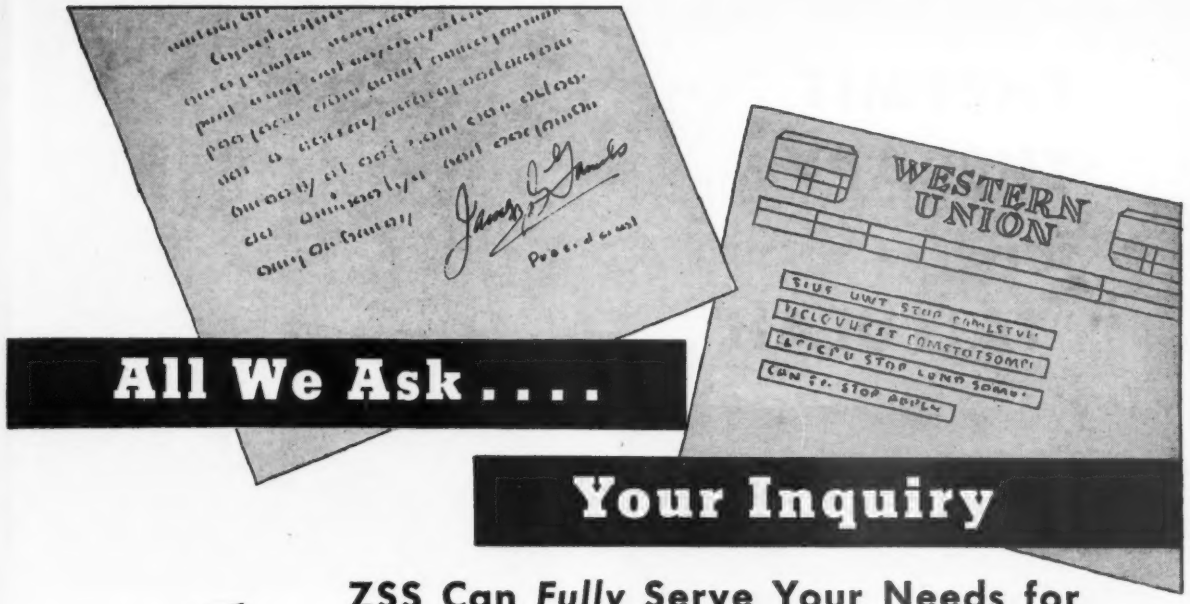
One hose connects to the torch; both electrical lead and compressed air line are included.

"The torch is most efficient and economical," says Mr. Chappie, "when removing cracks in the foundry cleaning room. Ribs, fins and riser pads can also be removed with ease. The continuous air flow results in a clean and smooth cut. Sand or dirt spots are readily removed, and the torch is more maneuverable than other torches. It is particularly adaptable in confined corners or places where the use of a chipping hammer is impossible. Shrinks under a riser are prepared for welding by the torch with less metal removed than results when chipping is employed.

How It Saves

"A review of a number of tests leads to the conclusion that in a given time, Arcair process could remove 200% more metal than could be removed by chipping. Another way of saying this would be that one Arcair cutter can replace three chippers. All tests were made on a .25% carbon steel. When used on alloy metals, the method would allow further savings."

This unit was invented by Myron Stepath of the Bremerton Navy Yard staff. It is now manufactured by the Arcair Co., Bremerton, Washington.



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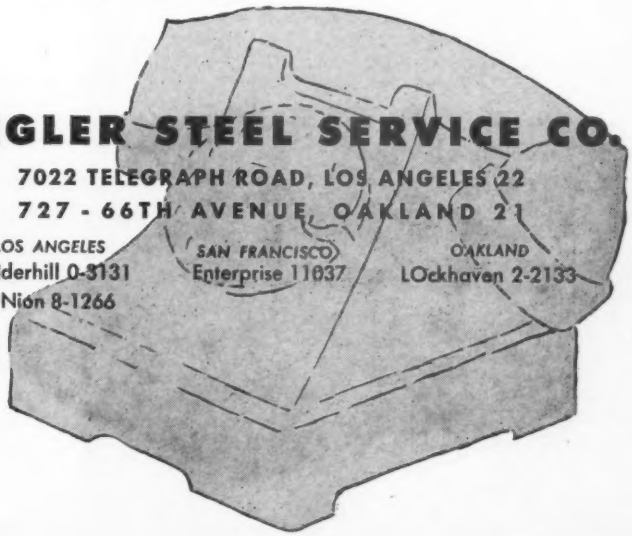

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THERMIT THERAPY for "TALLULAH"

CRACK in "Tallulah's" stern is first burned through with an oxygen-acetylene torch (left). All surfaces are thoroughly ground and cleaned to a bright finish to remove all oxides.

AFTER a beeswax mold has been made, a temporary portable cupola (above) is built above the stern frame section to be welded.

WHEN A NAVAL TANKER like *Tallulah* is suffering from such an infirmity as a crack in her stern frame, the welding process known as Thermit is an ideal remedy. This process can mean a rapid recovery to any lady in Tallulah's shoes because it permits quick repair of heavy parts which would normally take months to replace.

Thermit is a mechanical mixture of finely divided metallic aluminum and metallurgically processed iron oxide to which are added manganese and carbon and sometimes nickel, molybdenum, chromium or vanadium. When this prescription is fired with a special ignition powder, which produces a temperature of 2,800 deg. F., a vigorous reaction takes place: the aluminum combines with the oxygen of the iron oxide, becoming aluminum oxide, thus leaving steel.

No matter how much Thermit is used, this forcible reaction takes only about 30 seconds. It produces a temperature of about 5,000 deg. F., or approximately twice the heat of molten steel. Steel formed in this manner has a highly liquid quality and separates itself entirely from the aluminum oxide which floats on top as slag. Although cast, the weld metal has physical properties closely approaching those of forged steel.

Such a large casting cannot satisfactorily be welded manually, since it cannot be heat treated, thus relieving stresses set up in the metal during the welding process. Also, replacement of an entire frame is very costly. With a Thermit weld, however, the metal actually stress-relieves itself during the slow cooling process, from a high temperature during the reaction of about 5,000 deg. F., to 200 deg. F. over a period of 16 hours.

THERMIT metal is ignited. At temperature of over 5,000 deg. F., cupola gate is opened and molten metal flows into pre-heated sand mold surrounding portion to be welded.

AFTER 16-hour cooling-off period, "Tallulah's" wound is completely healed.

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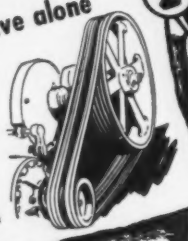
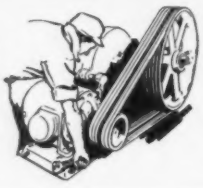
- ...uneven sheave wear
- ...less production



2 Slide the motor back

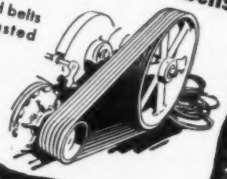
Tight belts get too tight

Life of belts and bearings is reduced



3 Install a new set of belts

Discarded belts mean wasted money



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TREATING

CASE HARDENING with the NITRIDING PROCESS

By
V. O. HOMERBERG
Sc. D.
Professor of Physical Metallurgy, Emeritus Massachusetts Institute of Technology
Consultant for Joseph T. Ryerson & Son, Inc., Los Angeles and San Francisco

CASE-HARDENING depends upon the introduction of carbon or nitrogen or both into the surface of a steel, usually followed by quenching from a comparatively high temperature.

The common carburizing method introduces carbon into the surface through the medium of carbon monoxide which is formed in the process. The well-known cyaniding process impregnates the surface of the steel with both carbon and nitrogen. It is used generally for producing a thin case by immersing the parts in a fused cyanide bath followed by quenching.

What It Is

A more recent method of introducing nitrogen into a steel surface at a comparatively low temperature is known as Nitriding. The nitriding process consists in subjecting the heat-treated and machined articles to the action of ammonia gas under certain conditions whereby a remarkably high surface hardness is imparted to the parts without necessitating any further treatment.

Nitriding can be accomplished with a minimum of distortion. This is due to the low temperature at which the parts are case-hardened and to the fact that not any quenching is required after exposure to the ammonia. Great wear-resistance, retention of hardness at elevated temperatures, and resistance to certain types of corrosion are other properties imparted to nitrided steels.

Although several alloy steels, especially those containing chromium, can be nitrided to produce a surface hardness that is satisfactory for many applications, those which produce the maximum effect contain aluminum as one of the alloying elements and are known commercially as Nitralloy.

The composition of the most commonly used type of Nitralloy is as follows:

Nitralloy 135M

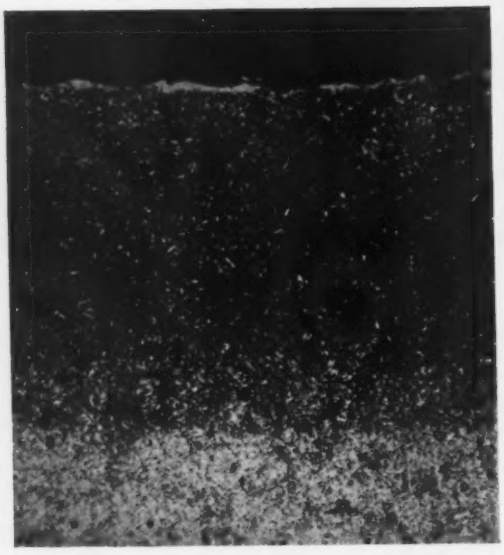
Carbon	0.38—0.45
Manganese	0.40—0.70
Silicon	0.20—0.40
Chromium	1.40—1.80
Aluminum	0.85—1.20
Molybdenum	0.30—0.45

Nitralloy is generally provided in the heat-treated and machinable state. This is desirable whenever the parts are to be machined from bar stock. It is not necessary to use such stock when forgings are to be made since the forged parts have to be heat-treated for machining and nitriding.

The mechanical properties of Nitralloy 135M after heat-treating are given on this page. Tensile test specimens were oil quenched after holding

Mechanical Properties of Heat-Treated Nitralloy 135 Modified

Tempering Temp., ° F.	Yield Point psi.	Ultimate Strength psi.	Yield Ratio	% Elong. in 2 in.	Reduction of Area	Hardness Rockwell C Scale	Hardness Brinell
1,000	181,500	206,000	0.89	13.2	45.8	44.6	415
1,100	165,000	181,000	0.91	15.5	54.3	41.0	368
1,200	141,000	158,750	0.89	17.5	55.8	36.0	320
1,300	125,000	145,000	0.86	20.5	64.5	32.0	285



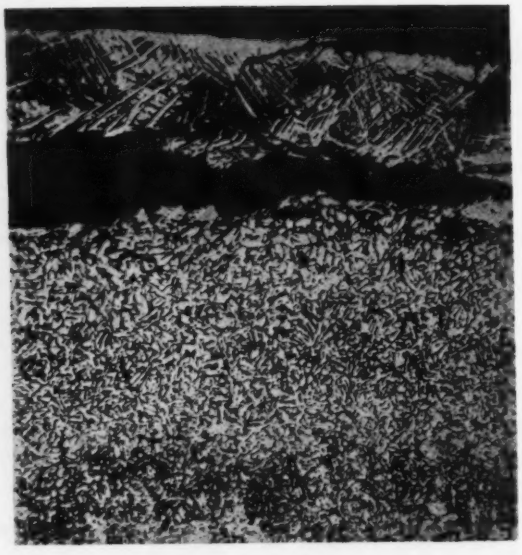


FIGURE 1 (top)—Blisters on shaft caused by nitriding decarburized material.

FIGURE 2 (left)—Photomicrograph showing nitride case produced by nitriding heat-treated Nitralloy. 100X.

FIGURE 3 (right)—Showing spalling of nitride case as the result of nitriding decarburized Nitralloy. 100X.

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½ hour at 1,700 deg. F., and tempered for one hour at the temperatures indicated.

Certain precautions must be taken before the parts are nitrided. All traces of decarburization must be removed in machining; otherwise the nitrided surface will be very brittle and tend to spall. See Figures 1, 2, and 3 on page 90.

Eliminating Stresses

Since machining produces internal stresses in the parts, these stresses should be eliminated prior to nitriding by reheating to a temperature of 1,000-1,200 deg. F. between the rough and finish machining or grinding operations prior to nitriding in applications where close dimensional stability is required.

Nitriding as conducted commercially consists in subjecting heat-treated and machined articles to the action of ammonia gas at temperatures ranging generally between 950 and 1,050 deg. F.

When the ammonia comes in contact with the steel surface, it decomposes to a certain degree into active nitrogen (atomic nitrogen) and active hydrogen (atomic hydrogen). It is nitrogen in this form which enters the surface of the steel where it combines with the aluminum to produce aluminum nitride. Particles of this compound in a finely precipitated state account for most of the high hardness of the case. Chromium nitride also contributes to this hardness.

Figure 4 shows the depth-hardness curves for Nitralloy 135M after nitriding at 975 deg. F. for various periods.

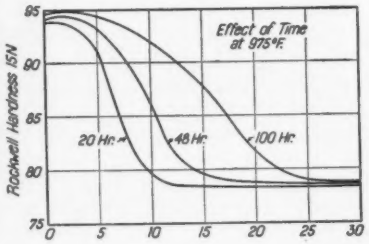

FIGURE 4—Depth-hardness curve for Nitralloy 135M after nitriding at 975 deg. F. for periods shown. Samples tempered at 1,250 deg. F. prior to nitriding. Depth below surface in thousandths of an inch.

The case hardness obtained by using the conventional methods of case-hardening usually ranges from Rockwell C62-65. To obtain this hardness, the parts must be quenched. It is easy to obtain the equivalent of Rockwell C70 by nitriding Nitralloy without any subsequent quenching. The depth of the nitride case as re-

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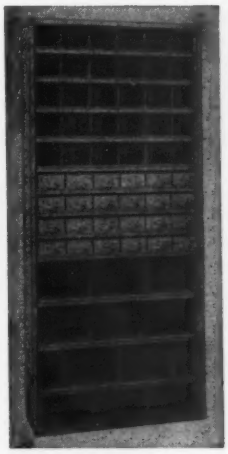

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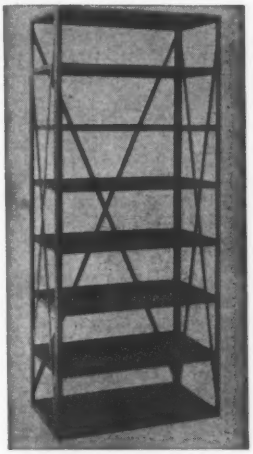

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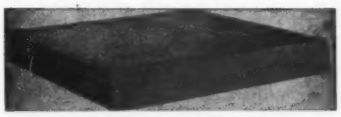

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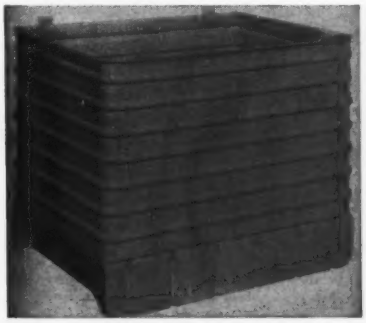

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lated to the time at temperature is shown in Figure 5.

Although special furnaces for nitriding are available, the essential requirement is that the furnace must maintain a uniform temperature within the nitriding container. This container should be made from a suitable material such as Inconel. Also there must be provision for circulating the ammonia to insure uniform nitriding.

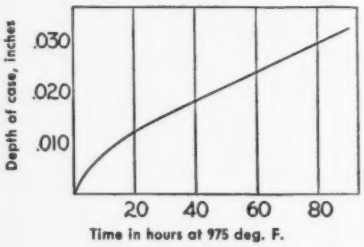

FIGURE 5—Depth of nitride case versus time at temperature 975 deg. F.

The extent to which ammonia dissociates is dependent upon the rate of flow of the gas, the temperature and the amount of surface exposed by the parts being nitrided, the container walls and the fixtures. The nitrided surface acts as a catalyst to increase the dissociation with the same rate of flow.

The inventor of the nitriding process, Adolph Fry, recommended a dissociation of about 30%. This value is maintained by regulating the rate of flow of the gas. The catalytic effect of the nitrided surface will increase this degree of dissociation. To maintain the 30%, an increase in flow of the ammonia is required. One of the principal costs of the process is that of the ammonia.

In conducting the Fry nitriding process, the outermost surface of the steel is converted entirely into nitrides. This region is known as the "white layer" and generally must be removed by grinding since it is somewhat brittle. It varies in depth from 0.001 to 0.002 in., depending upon the time of nitriding.

A great deal of research has been conducted to correct the faults of the Fry process, i.e., (1) the additional cost of the ammonia as the result of increasing the flow to maintain a dissociation of 30%; (2) the "white layer"; and (3) the necessity to grind after nitriding.

Floe* succeeded in overcoming the objectionable features of the Fry process, which it is rapidly displacing.

*Dr. Carl F. Floe, Professor of Physical Metallurgy, Mass. Inst. of Tech., and Associate Technical Director of the Nitralloy Corp., U. S. Patent 2,437,249.

In the Floe process the dissociation is kept at 20-30% for about 10% of the nitriding cycle, after which it is increased to 80-85% for the remainder of the period. A comparison of the depth of the white layer produced by the two methods is shown in Figures 6 and 7.

FIGURE 6—Structure of nitrided case produced by nitriding for 36 hours at 975 deg. F. with 30% dissociation (Fry Process).

FIGURE 7—Structure of nitride case produced by nitriding for 5 hours at 30% dissociation, followed by 43 hours at 85% dissociation (Floe Process).

Since the case hardness is produced by the precipitation of nitrides, some change in volume is to be anticipated, resulting in dimensional growth. The amount of growth is constant under the same conditions so that, after it has once been determined for a given material or article, it can be allowed for in the final machining or grinding, or it can be removed by lapping or grinding of the nitrided part. An increase in diameter of 0.002 in. in a solid specimen having a case depth of 0.030 in. serves as a fair example of

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the extent of this growth.

A variation in the internal growth takes place in the nitriding of rings or hollow cylinders. Figure 8 shows the change in dimensions of hollow cylinders with varying wall thicknesses.

Areas to be protected against nitriding are generally tin or copper plated. If tin is used, the thickness of the coating must not exceed 0.0003-0.0005 in. because of its low melting temperature and its tendency to "run" if the amount exceeds that held by surface tension. Copper-plating† when properly used gives excellent protection.

A protective paint known as Sel-Nite‡ gives satisfactory results when proper precautions are taken. The paint should be permitted to dry before placing the parts in the furnace.

One of the valuable properties imparted to a steel by nitriding is improved fatigue resistance and decreased notch sensitivity. Compressive stresses are created in the nitrided surface. Before a localized tensile stress can indicate a fatigue crack, it must first overcome the compressive stress.

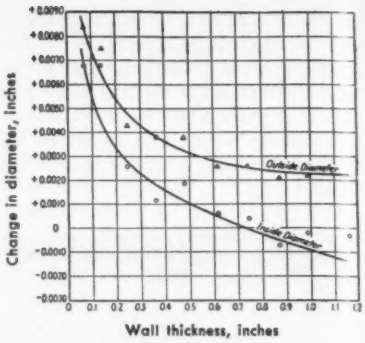

FIGURE 8—Growth in rings or cylinders of Nitralloy 135 due to the nitriding procedure (Hubbard and Robinson). Nitrided at 975 deg. F. for 72 hours.

The improved endurance limit or fatigue resistance and decreased notch sensitivity of nitrided Nitralloy is shown on this page. The heat-treated specimens (Brinell 289) were 18 in. long and ½ in. in diameter. They were ground and polished and nitrided at 975 deg. F. for 40 hours. The circumferential groove and the "V" notch were 0.010 in. deep with a radius of 0.005 in. and an included angle of 50 deg. in the former and 60 deg. in the latter.

Endurance Limit of Nitralloy—Un-nitrided and Nitrided

	psi.
Un-nitrided without notch	45,000
Nitrided without notch	90,000
Un-nitrided with half-circle notch	25,000
Nitrided with half-circle notch	87,000
Un-nitrided with "V" notch	24,000
Nitrided with "V" notch	80,000

The origin of a fatigue failure in nitrided Nitralloy is between the case and the core and does not start from the surface. Small surface defects, therefore, are not very important.

The hardness of nitrided Nitralloy is the same at 750 deg. F. as at room temperature and therefore possesses marked advantages over the ordinary case-hardened steels and hardened steels which soften when heated to this temperature. Nitrided Nitralloy is therefore less susceptible to galling and scoring than these steels. There are industrial applications in which Nitralloy is run against itself under

† See a discussion of this matter, including plating methods, thickness and effect of prior surface finish, by W. V. Sternberger and E. R. Fahy in *Metal Progress* for February 1945 (page 278), December 1945 (page 1311) and October 1946 (page 673).

‡ National Copper Paint Corp., Chicago, Illinois.

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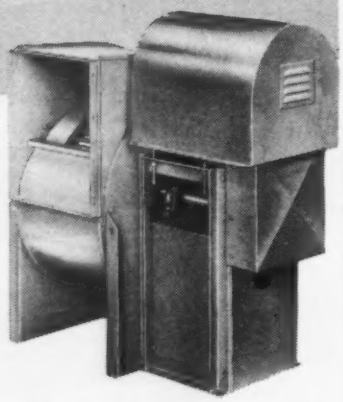
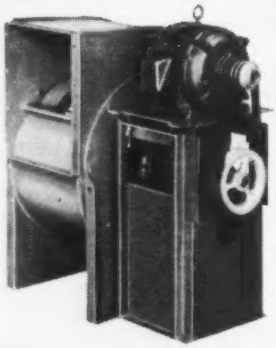


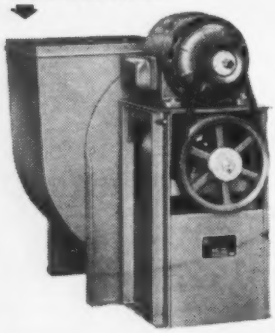
This self-contained vent set combines blower, motor and drive in one package, making installation easier and more inexpensive. These sets are available in a complete range of sizes up to 15,000 CFM and are suited for any kind of exhaust or air supply problem.

Designed for convenience, the motor is mounted high where it can be easily observed and serviced. Adjusting belt tension is also simplified, requiring only the turning of the leveling screws in the four corners of the motor bed plate.



Where installation is made outdoors, unit is equipped with weatherhood for protection of motor and drive. Hood is easily and quickly removed for inspection and adjustment of belts.

All-purpose vent set, Class II construction with heat slinger and bearing cooling fan for induced draft service.



All standard MASTER vent sets are of regular Class 1 or heavier construction. Standard performance ratings apply. You will find MASTER all-purpose vent sets more efficient in performance, quieter in operation and easier to service. Specify MASTER FANS for your next air moving job.

MASTER FAN CORP.
1323 Channing St., Los Angeles 21, Calif. VA 1037

conditions where faulty lubrication may be encountered resulting in a marked increase in temperature at the contacting surfaces.

BRIEFLY, nitrided Nitralloy can be employed most advantageously in applications where one or more of the following properties is desirable:

1. High hardness to provide maximum wear resistance.
2. Minimum distortion. Since the nitriding temperature is low and no subsequent heat-treatment is required after nitriding, very little if any distortion will take place in many applications.
3. Increase in endurance limit.
4. Retention of hardness at elevated temperatures. Besides being as hard at 750 deg. F. as at room temperature, nitrided Nitralloy can be heated to 1,200 deg. F. for a considerable period of time without loss in hardness when tested at room temperature.
5. High mechanical stability; nitrided Nitralloy is ideally suited for applications such as gages, fuel injector parts, valves, etc.
6. Resistance to certain types of corrosion. Although nitrided Nitralloy resists to a marked degree the action of alkalies, atmosphere, crude oil, natural gas combustion products and tap water, it should not be placed in the same classification as stainless steels. The outermost part of the case exhibits maximum corrosion resistance and for that reason the parts should be left in the condition, as far as possible, in which they come from the nitriding furnace.

HOW MUCH LOST PRODUCTION DO SLIPPING ACCIDENTS COST YOU!
ACCIDENT REPORT
Cause of accident:
Man slipped on oily machine-tool base.
Means of prevention:
Install A.W. ALGRIP Abrasive Rolled Steel Floor Plate.
Count the cost of slipping accidents—in lost man-hours, production lag, and insurance premiums. We think you'll see, at once, how much less it costs to put positive non-slip protection in your plant with exclusive A. W. ALGRIP Abrasive Rolled Steel Floor Plate.
NON-SLIP—EVEN ON STEEP INCLINES!
We make ALGRIP by rolling rough, tough abrasive grain (the kind you'll find in grinding wheels) uniformly as an integral part of the steel plate's upper portion. Hundreds of these tiny abrasive safety brakes grip your feet at every step—prevent slipping, even on wet or oily surfaces, even on steep inclines!
ALGRIP WON'T WEAR SMOOTH!
ALGRIP's safety is more than surface deep. The abrasive grain is distributed evenly and deeply, so that as the surface wears, new particles are exposed. Result: ALGRIP keeps its anti-skid qualities for a lifetime—without maintenance. And because rolled steel makes it stronger than other abrasive floorings, ALGRIP withstands hard blows and heavy loads—can be used in thinner sections without reducing load carrying capacity.
LEARN HOW LITTLE SAFETY COSTS TODAY
Our new Booklet A-6 gives full technical details, suggests uses for ALGRIP. We'll be glad to send you a copy and answer any questions you may want to ask—without obligation. Write us today.
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CONSHOHOCKEN, PA.
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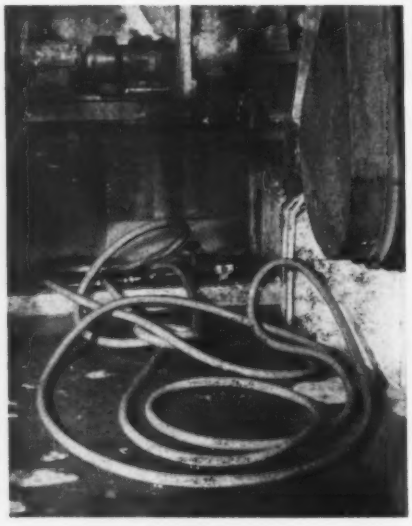
AIR HOSE... for All Pneumatic Tools

The Goodall line includes Air Hose of various styles in wrapped duck, molded-and-braided and sheeting constructions . . . covering the full range of pneumatic tool applications . . . from chipping to heavy-duty rock drilling. "Subway," "Mine King," "37" and "Chipper" are names that mean *maximum* in every characteristic desirable under the service conditions for which each brand is designed.



WATER HOSE For Production and Wash-up

Name any application for Water Hose, and you'll find a Goodall brand that will fill the bill with outstanding reliability and economy. "Buckskin" and "Bellwood" will meet practically all cold-water requirements. Use "CLOVER-LEAF" Creamery Hose for scalding water wash-up. Other special-purpose constructions include Paper Mill, Greenhouse, Street and Sewer Flushing, Car Wash and Deck Hose.

Contact the nearest Goodall branch for complete information on the hose mentioned above, or any other industrial rubber products you may need—steam, acid, or fire hose; conveyor, transmission or elevator belting; packings; clothing, gloves, footwear for plant or laboratory.

PARTICIPATING IN THE MANAGEMENT AND FINANCING OF KENTUCKY SYNTHETIC RUBBER CORPORATION

GOODALL RUBBER COMPANY

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Est. 1870

Western Confidence versus National Pessimism

GRAPHIC EVIDENCE of his confidence in the Western economy is Henry J. Kaiser's $65,000,000 announced investment in expansion of Kaiser Steel Corporation's Fontana facility. This faith in our future is shared by seven banks and seven insurance companies who, between them, are providing $55,000,000 of the investment.

This expansion will mean an increase in Kaiser's pig iron output by 50%. It will raise steel ingot production by more than 11%. And it will put Fontana at about the same physical size as Geneva or Pueblo, with an investment (at that stage) of $260,000,000 and an estimated replacement value (today's prices) of about half a billion dollars.

It will mean an additional 1,000 operating personnel, from mine to mill. It will mean about 100 new homes to be built at the Eagle Mountain ore mine. It will mean about 100 more new homes to be built at the Sunnyside, Utah, coal mine.

It will include, in addition:

1. A third blast furnace to smelt 438,000 tons of pig iron per year.
2. A ninth open hearth steel making furnace to add 156,000 tons of steel ingots annually to the Fontana production.
3. Ninety additional by-product coke ovens to turn out 408,000 tons of coke per year for use in the blast furnaces.
4. Two additional stands in the present hot strip mill, to enable it to roll and finish sheet of lighter gauges and greater widths.
5. Major additions to equipment at company-owned iron ore and coal mines.

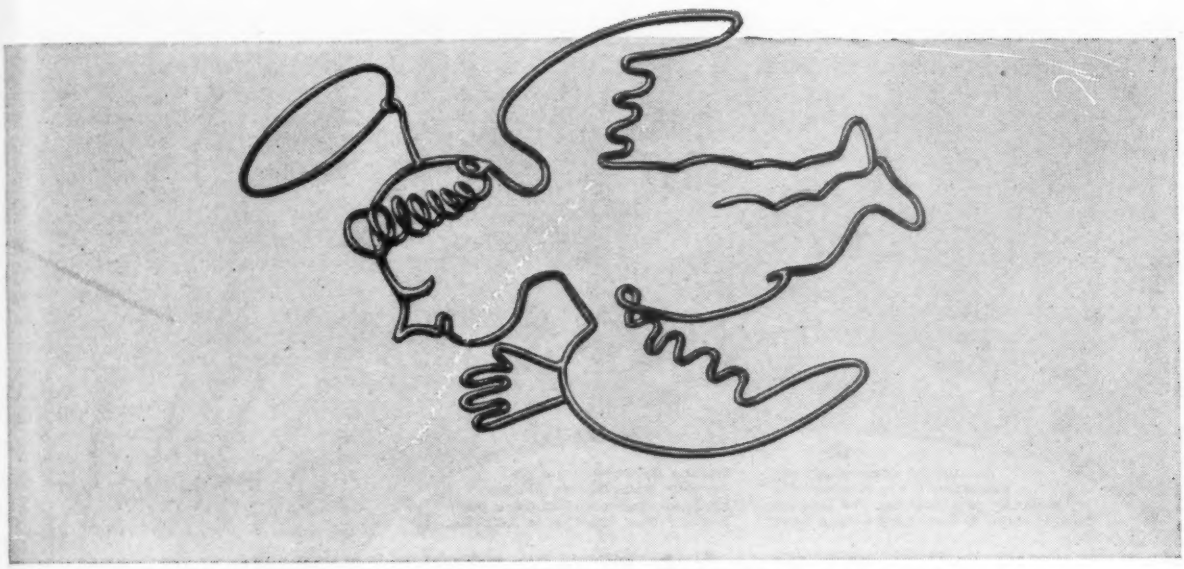
Steel Statistics . . .

STRIP (Cold Rolled)

As of January 1951
Source: American Iron & Steel Institute

COMPANIES	ANNUAL CAPACITY (Net Tons)
California Cold Rolled Steel Corp.	24,000
Kaiser Steel Corporation	43,000
Total	67,000

THE WIRE
WITH THE **Perfect Temper**



Many a production man thinks Chase engineers are "angels" for producing wire that unwinds from the coil smoothly and without twist. It's uniform in gauge, temper and color; has superior heading or flowing characteristics.

There's a Chase wire for most applications. Write for *FREE* booklet—"Chase Cold Heading Extruded Brass and Copper Alloy Wire" giving physical and fabrication properties, applications, weights per 1000 feet and feet per lb.

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● **CHASE TECHNICAL SERVICE**
Our metallurgical engineers are familiar with military specifications for brass and copper for ordnance components, and will be glad to consult with you on the selection of these metals for defense orders.

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SEATTLE 4, WASH. • 1957 First Ave., South, Tel. SEneca 1862
DENVER 2, COLO. • 1421 Court Place, Tel. AComa 3685 (Sales Office)

Carrier at intermediate station where it has stopped automatically as preselected. The Tramrail track is about 30 feet above ground level.

Starting a heavy drum on its way from the warehouse by depressing a wall-mounted push button. Hoist capacity is 2,000 lbs.

Automatic Dispatch System Eliminates Need of Three 10-Ton Trucks

An outside system operating between three buildings

Not only was the need of two 10-ton trucks obviated by a Cleveland Tramrail automatic system at the Mica Insulator Company, Schenectady, N. Y., but the purchase of a third truck was made unnecessary. While the trucks had to travel over a circuitous route, only a short, straight Tramrail track is required for the overhead system.

Many man-hours of trucking and handling time are saved because materials dispatched over the automatic Tramrail system can be handled by production workers along with their regular jobs. A great amount of handling on an elevator has also been eliminated and better elevator service is available for other purposes.

The system has been found particularly helpful during night shifts when an extra drum of varnish or roll of cloth is sometimes needed. Formerly trucks were never available for night hauling. The Tramrail equipment paid for itself out of savings it created in a short period.

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THE CLEVELAND CRANE & ENGINEERING CO.
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CLEVELAND TRAMRAIL
OVERHEAD MATERIALS HANDLING EQUIPMENT

FOUNDRY

PERMANENT MOLD CASTING

A new fabrication trend?

By
NEWELL T. PARTCH
Factory Manager
Up-Right Scaffolds
Berkeley, Calif.

IN A SEARCH for the best possible manufacturing method for the joint members of its aluminum alloy scaffold, Up-Right Scaffolds, Berkeley, California, made thorough studies of forging, sand, permanent mold and die casting, press forming sheet metal and welding.

In judging the adaptability of each process, the three factors were considered in the following order of importance: (1) strength and ductility, including the ease of controlling these mechanical properties in quantity production; (2) unit cost; (3) appearance.

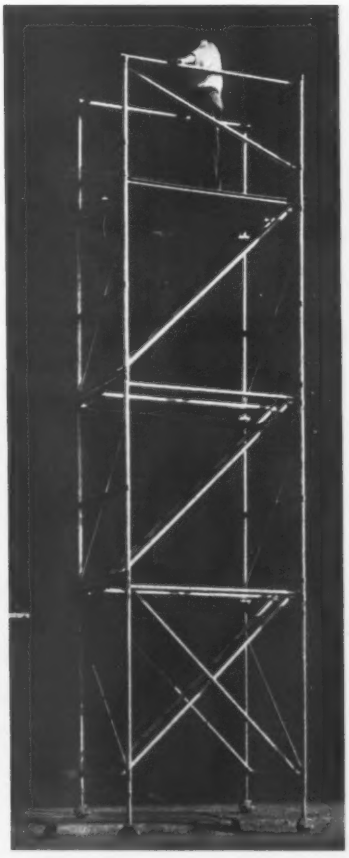
Why Pick This Method?

Permanent mold process was chosen since it embraces the best combination of these three factors for the scaffold business. Actually, a manufacturing method that is good in building scaffolds will also be good in many other businesses, and the many advantages of the permanent mold process predict a trend for tremendous increase in its use as its techniques become more familiar to more foundries.

Ease of maintaining a quality check on the casting production is one of the principal advantages of this permanent mold method.

If normal, good foundry practice is followed in charging the melting fur-

HUMAN SAFETY depends on good material, well made. This 3-section Up-Right scaffold is secured by the hook castings, shown below, cast by permanent mold.



The Lufkin Line

By VIC FAWCETT

Vic Fawcett

Ever stumble into something special on a business trip? Or, for that matter on most any kind of a trip? Something you enjoyed so much, that you'd like to share it with your friends? Well, I did recently — and before your imagination runs away with you, let me explain:

It's a place to stop. It's a hotel-motel, having the advantages of both, its hospitality, convenience, beauty and charm all rolled into one. It's the new Western Hills Hotel of Fort Worth, Texas. If you ever drive your car back "that-a-way" for business or pleasure you'll find this spot on Highway 180, just as you approach Fort Worth from the west.

Although swank in appearance, with lots of glass, flagstone, brick and tile, informality rules. Bellhops resemble cowpokes, and waitresses look good dressed up as cowgirls. The room clerk greeted us "How you-all." There's a heated pool surrounded by neatly-arranged cabanas for those preferring motel accommodations.

Enroute from Los Angeles to ***Lufkin*** to attend the annual sales meeting, Bob Spaulding, Carl Frazer and myself agreed this was a highlight of our trip.

All of which doesn't have a darned thing to do with ***Lufkin Gear Reducers, Lufkin High Speed Increasers,*** or ***Lufkin Pumping Units.***

However, when and if your attention turns to the selection of such heavy-duty equipment, engineered to provide long, trouble-free performance, you may be sure there will be no stumbling if the nameplate reads ***"Lufkin."***

OFFICES Pacific Coast Headquarters and Warehouse—located in Los Angeles at 5959 S. Alameda St. Agency—Adam Hill Co., 299 Ninth St., San Francisco.

That's all for now

Vic Fawcett

nace and handling the melt, it requires only two or three test bars for each batch of ingot to be sure of the properties. This can best be understood by considering the process itself.

Molding Process

In making a casting, the metal is fed into the cavity in a liquid state by gravity, as compared with a die casting where the metal is forced into the cavity under air pressure or by a piston. A gravity casting will, if it fills the cavity completely with no surface indication of shrinkage, be a consistently sound casting free of any porosity or voids since the metal can flow in the cavity only in the fluid state.

A pressure casting may, however, have every appearance of having filled the cavity completely because the metal was forced in under sufficient pressure, but air may have been entrapped in the metal to cause hidden porosity or voids. This porosity can occur in varying locations in the cavity, even though casting conditions are held constant—the locations can change from one shot to another, or appear or disappear during a run on a given cavity with no visible evidence of the change on the surface of the casting.

Although such internal defects do not affect the dimensional accuracy of the casting, they obviously affect the strength and make it unwise to use pressure castings as structural parts unless 100% X-ray inspection is permissible.

Alloy Used

Aluminum alloy No. 356 was selected for use in Up-Right scaffolds since (1) it can be heat treated to the T-6 condition which produces excellent mechanical properties, (2) it handles well in permanent molds, and (3) it is a weldable alloy and can be joined by the inert gas shielded arc to the tubing used in the scaffolds.

In practice, this alloy as cast in a permanent mold, without machining, but treated to the T-6 condition, tests consistently at 40,000 psi. tensile strength and 12% elongation. This approaches the properties of the wrought alloy of the scaffold tubing and is very satisfactory in use.

Cost Factors

Unit cost actually involves many economic factors in addition to the cost of producing just a finished casting, forging or fabricated joint. The effect of dimensional tolerance, for instance, is evident in both machining and assembly operations.

Here again the properties of permanent mold castings make them the economic choice over other methods of manufacture. By careful control of the mold cavities with respect to the mold wash thickness, fit of the cores, etc., it is possible to maintain a .005-in. tolerance range on various casting dimensions such as diameters of 1½ in. to 2 in.

Minimum Machining

Holding such close tolerances naturally requires more time than would be considered standard practice in a permanent mold foundry. But, since the joint casting made with this tolerance can be assembled with its mating parts without further machining and handling operations, the casting operation can justifiably absorb more production time—and the permanent mold process has the flexibility to

Continued on page 102

FOUNDRY SET-UP showing transfer of molten metal to holding furnace and casting operation.

GROUND-LEVEL EFFICIENCY

FROM 3 TO 24 FEET

Adjustable, portable work platform . . . holds the man up to the job — safely

WEBER *Aerostand*

★ SAVES MAN-HOURS ★ INCREASES EFFICIENCY
★ CUTS ACCIDENTS

widely used in:

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- Oil refineries
- Building construction
- Factory maintenance
- Aircraft assembly, service
- Television studios
- Agriculture
- Many other industries

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☐ Would like additional information

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PERMANENT MOLD CASTING

. . . begins on page 99

permit this.

In building a quality scaffold the appearance of the finished product must be in keeping with the strength and good workmanship that are an inherent part of the scaffold. The appearance must reflect this quality since many customers will judge the merits of a product by its looks.

By heat treating No. 356 alloy gravity cast permanent mold castings in a controlled atmosphere furnace they come through with a smooth, bright, blister-free finish that can be matched only by a forging for sound, rugged appearance.

Porosity that may occur in a pressure die casting invariably produces a blistered surface when the casting is heat treated, and the cost of buffing or polishing the part to remove this surface imperfection precludes the use of the process where a heat treated alloy is required in the product.

Precision Casting

To produce permanent mold castings of this quality, the metal must be clean, free of oxides and dissolved gas, and must be held precisely at the best pouring temperature for a given mold.

One method of accomplishing this is to use separate melting and holding furnaces and by melting the metal electrically with low frequency induction furnaces. The Ajax installation shown in the accompanying photograph has proven very satisfactory.

Large variations in metal temperature when fresh pigs are charged are of no concern. Most of the oxides and other impurities are removed from the melt by the magnetic field in the melting channel area and cling to the walls of the melting channel where they can be removed later. Also this same magnetic field constantly agitates the molten metal so that all the alloying elements are uniformly distributed throughout the melt.

Molten aluminum is transferred to the holding furnace as needed and a very small amount of current is required to keep the molten metal at the proper pouring temperature. Metal is held within five deg. F. of this temperature, so that as the metal is ladled from the holding furnace to the mold continuously through the shift, casting conditions will be held constant.

Actually, this temperature may be varied from one mold to another or to suit the molders' speed. As the operator pouring the mold picks up skill and speed, the pouring temperature may be lowered. The objective is to keep the molding cycle time as short as possible, so, by lowering the temperature of metal poured into the mold, the amount of heat the mold must dissipate to solidify the casting is reduced.

As metal temperature is reduced then, the operator must also decrease the cycle time in order to keep the mold at proper working temperature. This flexibility in temperature with accurate control is an important part of a good permanent mold foundry.

Wide Use Anticipated

Properties of permanent mold castings discussed here make them useful also as non-structural parts in other articles, such as appliances and automobiles.

Dense metals, with lack of even a pin-point porosity at the surface of the casting, can take a decorative chrome plate with a minimum of surface preparation. For this reason it is logical to expect a wider use of permanent mold castings for such applications, and in this high volume field it is also logical to expect further refinements in mold design, mechanization and pouring techniques that will make permanent mold castings even more competitive from a cost standpoint.

A Tee in the Hand is worth two in the bush

When you need industrial pipe, valves or fittings—don't beat the bushes looking for them—call Thaler Pipe and Supply Co., specialists in this field. Thaler handles nothing but this type of equipment and stresses service.

The Flagg tee shown above is just one of the top quality lines carried by Thaler. Warehouses in Oakland and San Jose to serve you better.

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Pipes, Valves and Fittings for all Industrial Uses

Steel Statistics . . .

BLAST FURNACES

As of January 1951
Source: American Iron & Steel Institute

	PIG IRON	
	No. of Stacks	Annual Capacity (Net Tons)
CALIFORNIA		
Fontana—Kaiser Steel Corp...	2	876,000
COLORADO		
Pueblo—Colorado Fuel and Iron Corporation.....	4	918,000
UTAH		
Geneva—Geneva Steel Co...	3	1,200,000
Ironton—Kaiser & Frazer Parts Corporation	1	300,000
Geneva Steel Company.....	1	199,200
Total Utah	5	1,699,200
TOTAL	11	3,493,000

SHEETS (Cold Rolled, Galvanized)

As of January 1951
Source: American Iron & Steel Institute

	ANNUAL CAPACITY (Net Tons)	
COMPANY	Cold Rolled Sheets	Galvanized Sheets
Columbia Steel Div., U. S. Steel.....	169,020	131,600
STATE		
California	169,020	131,600

BOLTS, NUTS, RIVETS AND WASHERS

As of January 1951
Source: American Iron & Steel Institute

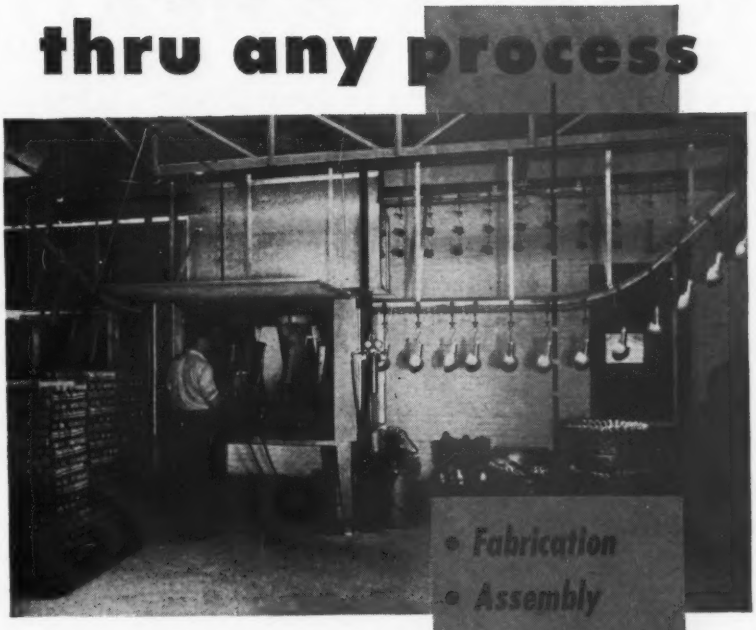
COMPANY	ANNUAL CAPACITY (Net Tons)
Bethlehem Pacific Coast Steel Corp.....	32,000
STATES	
California	24,000
Washington	8,000
Total	32,000

TOTAL FINISHED HOT ROLLED PRODUCTS

As of January 1951
Source: American Iron & Steel Institute

COMPANIES	ANNUAL CAPACITY (Net Tons) STEEL
Bethlehem Pacific Coast Steel Corp...	622,000
Colorado Fuel & Iron Corporation....	1,018,500
Judson Steel Corporation.....	54,000
Kaiser Steel Corporation.....	888,000
Oregon Steel Mills.....	100,000
Northwest Steel Rolling Mills, Inc....	25,000
Pacific States Steel Corporation.....	155,000
Simmons Company	12,000
Columbia Steel Div., U. S. Steel.....	847,020
Geneva Steel Div., U. S. Steel.....	1,595,000
	5,316,520
STATES	
California	2,402,020
Colorado	1,018,500
Oregon	100,000
Utah	1,595,000
Washington	201,000
	5,316,520

Carries loads thru any process



WEBB "Junior" CONVEYOR

KEEP PRODUCTION MOVING ALONG with Webb "Junior" Conveyor. It carries light loads fast or slow, travels through spray booths, baking ovens or cleaning units. "Junior" turns in any direction, moves horizontally . . . goes up or down from one level to another, if desired. By means of specially designed hooks it will carry any kind of load.

"Junior" can go where workmen can't—through heat, acid spray, cleaning, painting and drying machines. With proper baffling, this conveyor carries products without injury to itself. Can be routed to coordinate and pace production.

INSTALL IT YOURSELF

Easy to install, Webb "Junior" Conveyor has a bolted hanger assembly, may be hung from the average plant ceiling structure by your own shop crew.

Get all the facts; write for folder today!

WEBB

Mfrs. of continuous overhead conveyors. Powered floor conveyors. Drag chain conveyors. Pallet conveyors.

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WHAT'S AHEAD FOR THE METAL AND METALWORKING INDUSTRIES OF THE WEST

Exclusive reports from the Western chapter chairmen of the American Society for Metals

Atomic energy development stimulates new metals

By

GEORGE L. FLINT
Chairman, Columbia Basin Chapter
Metallurgist Engineer
Separations Technology Unit
Engineering Department
Hanford Works
General Electric Co.

IT IS A GOOD BET that the future of the metal industry in the West will be greatly benefited by the present expansion which is going on at the Atomic Energy installation at Hanford, Washington. Hanford is one of the major producers of fissionable material needed for national defense and as one can observe in news stories, the plant is now expanding, due primarily to the critical international situation.

Undoubtedly, the bulk of the tonnage of the common metals needed for this expansion will come from the metal fabricators and suppliers of the West because of the proximity of these industries. There will be needs for structural and reinforcing steels for pile applications and chemical plants, aluminum and stainless steels for resistance to corrosion by water, acids, and special chemicals; not to mention copper for electrical uses. In addition, sizable amounts of the rarer metals such as platinum, silver, zirconium, titanium, beryllium, and cadmium will be consumed.

In the past many have considered Hanford essentially a chemical plant, processing materials from the piles, but actually there is considerable metal fabrication being carried on at all times. Some of these metals are unique in the annals of metallurgy and therefore have presented problems that require special and ingenious methods of handling and fabrication.

In order to accomplish this purpose it has required metallurgical engineers with diversified interests and experiences. Many of these men are now at Hanford but much assistance has been and will continue to be gained from the Western metals men.

Perhaps the importance of metallurgy at Hanford can no better be shown than to mention the formation of the new chapter of The American Society for Metals which was initiated this year. In the short space of eight months the membership has more than doubled.

The utilization of the wide range of metals which are required for expansion as well as normal operation and maintenance presents many problems commonly encountered by the metal industry in general. One of these problems currently under consideration, which will have a direct bearing on the metal industry, is that of material utilization with regard to critical material. The first stage of this program is to substitute, wherever possible, straight chromium steels for the more critical 18-8 type stainless steels.

* * * * *

Process plants today give metals a challenge

By

WILLIAM F. NASH, JR.
Chairman, Los Angeles Chapter
Factory Superintendent
C. F. Braun & Co.
Alhambra

THE OIL AND CHEMICAL industries are large users of metals, and they will become larger users. In the near future, we may expect other types of process plants. Plants for atomic energy. Possibly plants to process oil from shale.

The West has a good share of the oil and chemical industries. A large atomic installation is in the Northwest. Large shale deposits exist in Colorado. All of which points to continued process-plant expansion in the West.

Not many years ago, process plants were built largely of carbon-steel, with a little brass. Now such plants require careful use of most of the available alloys. Carbon steel, in large tonnages, is still the backbone. But all the stainless steels are now used. Nickel-base alloys find more uses each year, as do the copper alloys and aluminum.

Temperatures always seem to be going up. Chromium and molybdenum steels find wider uses. Chromium is to combat graphitization at high temperatures. Molybdenum permits higher unit stresses at high temperatures. And, in general, corrosion increases with increasing temperature. The trend is from carbon-steel to alloy-steels.

To make the most of the available metals requires the utmost from engineers and fabricators. They must use the smallest amount of metal possible. Yet they must make the plant last for a good economic life. A knowledge of corrosion-resistant alloys is essential, and the know-how to build equipment from them is equally important.

Metal veneers solve some of our problems of corrosion resistance, least alloy possible, and economics. A thin layer

Continued on page 106

Now, more than ever before...

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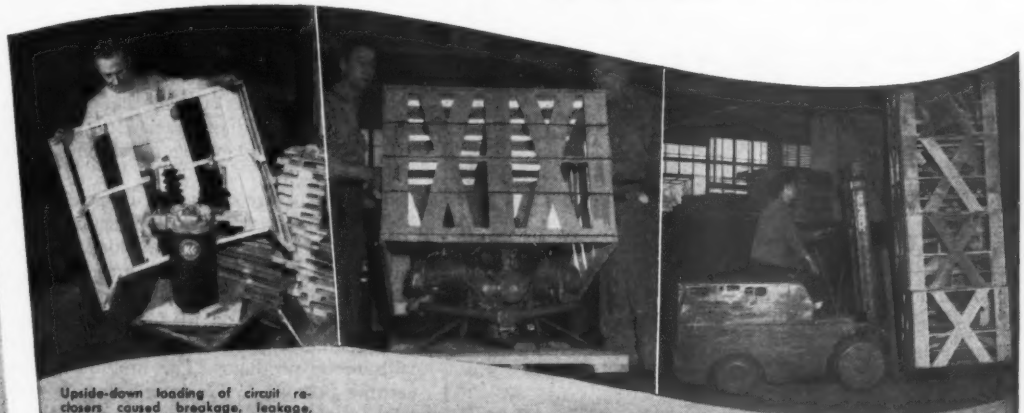

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of corrosion-resistant metal bonded to steel will often serve as well as solid alloy. In some instances, better. For example, a weak corrosion-resistant metal may be bonded to a strong backing-alloy. But to go with the advantages of clad and lined plates are some disadvantages. Our welding techniques become more difficult. We must provide for differences in expansion. And many other new design and fabrication problems arise.

We in the West are still somewhat dependent upon Eastern suppliers. We will see and participate in the continued development of process industries. To be successful in the West, we must learn to utilize all metals to their fullest extent. We must devote our energy toward improved designs and improved fabricating methods.

* * * * *

Small plants need big industry know-how

By

MAJOR
BENJAMIN B.
BULLWINKLE

Chairman, Oregon Chapter
Assistant Officer in Charge
Industrial Division Maintenance Shops
Far East Air Materiel Command
United States Air Force
(recalled from civilian life—
Powder-Power Tool Corp., Portland)

A NOTICEABLE TREND in the metalworking industries of the West is the growth of the small "job shops" to the status of small manufacturing plants. By the application of production machinery and fabricating equipment, the small shops are developing along very desirable lines.

More and more consumer items are being manufactured by Western industries for Western markets, tending toward the reduction in use of the old price notation, "Slightly higher west of the Rocky Mountains." In fact, in a number of cases the small Western manufacturer has been able to compete favorably on a nationwide basis.

This change over, from jobbing to manufacturing, is not without its problems. The first big problem is that concerning personnel. The small shop is not able at first to take on additional specialists, and the production problems must be solved by present supervisors and skilled mechanics who must learn and even devise new methods and conceptions of metalworking.

For a great number of years our educational facilities of the West have been equal to any other part of the nation, but the opportunity for the young graduate has been limited to a relatively few Western industries.

There is now a great need in the small plants of the West for the introduction of the modern technical knowledge and theory known only in the past to the few so-called "big industries." The small manufacturer needs the very latest metallurgical information and knowledge of heat treating, forming of metals, welding, and physical properties to cope with the many problems of material shortages, production difficulties, and the myriad of other problems facing him today.

Even in the simplest product the problem of quality control and interchangeability crops up somewhere in his production. These problems are all opportunities for the young college or technical trained men just entering industry in the West. Their technical and theoretical knowledge

combined with the practical experience of the older job shop craftsmen is the ideal combination for the development of new production methods and techniques necessary to compete.

There is very much written every day about the development of new metals. The high alloy steels for specialized uses, the new light metals such as titanium, and many others are discussed, but it is the opinion of the writer that the use and application of the presently available materials is far from exhausted. There are still many applications where low alloy steels will admirably perform a function if the proper technology is used in their application and in the manufacturing processes employed.

The increasing demand for aluminum for other than aircraft is proof enough that the application of this metal to old products is continuing, and its use in place of other materials is desirable in still other products. Casting techniques and materials are sufficiently advanced for this method to replace many wrought metal parts. It only takes the application of these advanced techniques by the small plant to his product not only to improve the product but at the same time to effect economies in his production.

Application of modern technical theory can be taken one step further, and by continual product examination development applying new methods and materials, the small manufacturer can keep ahead of competition from other areas. The application, on a limited scale, of the laboratory control and development as used by the very large manufacturing industries, can enable the small specialized plant to compete and surpass the larger but more diversified company.

This work is an excellent opportunity for the young technical graduate to gain wide experience in development work and at the same time experience in solving the many production problems that of necessity fall to one or only a few men in a small shop where the technical staff is limited. There is an especially large need for such men and application of technical theory in the metal working industry from the small foundry to the small consumer products manufacturer.

* * * * *

More and more metal industry developing in the West

By

JACK JONES

Chairman, Utah Chapter
District Manager
Pacific Metals Company, Ltd.
Salt Lake City

DEVELOPMENT of, and the continued long range planning for expansion of steel, aluminum and copper production in the West is resulting in real prophetic meaning to the advice, "Go West, young man," and this is the major trend as I see it.

When Geneva Steel began delivering finished products, industrial growth in this area was first noticed in the quite rapid expansion of already established and mostly locally-owned fabricating organizations. This did not go unobserved by large national concerns. Key executives began surveying the Intermountain area and some major plants have been built (Chicago Bridge & Iron, Eaton Metal

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Products and Commercial Shearing and Stamping, to name a few) and others will follow.

NPA regulations pretty much confine new uses here to the AEC and Dugway Proving Ground projects. Withdrawal of restrictions will bring stepped up demands for stainless steel and alumilited aluminum for architectural uses, aluminum and magnesium in the transportation field, as well as corrosion and heat resisting materials for our growing oil and chemical industries.

Heat and corrosion resisting materials for the atomic energy and jet programs seem to offer the greatest potential for immediate development. However, I believe the weight factor will also be a major consideration in the future and that aluminum will play an increasingly important role. In addition to its many uses in transportation and architecture, it should find its place in the mining industry for use as mine timbers, fabricating light weight cages and skips, and piping for portable ventilating systems.

Immediate industry demands for new types of metal should be mostly for the heat and corrosion resisting material needed by the atomic energy and jet programs.

The last war found most of our Intermountain fabricators short of equipment and know-how needed to bid successfully for large contracts, but typical Western resourcefulness and progressive planning has very largely eliminated this condition.

Today most of our Intermountain plants have the very latest equipment, such as power presses and breaks, X-ray, automatic welding set-ups, etc., and with it well trained and experienced personnel, who take pride in delivering only top quality products, economically produced, using modern techniques.

Management needs mostly time to continue its efforts toward acquainting (educating) the large users of their types of products with these facts. The accomplishment of this objective will see more and more of the lucrative contract awards moving West.

* * * * *

Steel picture for 1952 looks very good

By

GEORGE E. LUNDBERG

Chairman, Rocky Mountain Chapter
Mechanical Inspector
Colorado and Southern Railway
Denver

HAVING A CLOSER CONTACT with the various foundries than with some of the other metal industries, I find that even with the numerous restrictions and regulations, the outlook for the year is very good.

The steel foundries indicate they are able to get sufficient materials to meet their demands for castings. There is of course, the control on molybdenum, aluminum, etc., and in order to improve the situation and cut down on the use of some of these metals, I have been advised by one of the large foundries that they are considering the use of

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boron to replace molybdenum. This, I understand, is being done by some of the Eastern steel foundries with good success.

Although scrap has been scarce, the cast iron foundries have been able to get sufficient amount for their requirements, together with other elements. They also are using the newer materials to improve their product. In this regard, I know of one foundry that has been adding tellurium to the ladle to control the chill depth of the casting.

The brass and aluminum foundries are so far able to secure all necessary materials for their casting needs. Slab or bar copper is hard to secure but scrap copper is available in quantities desired.

In the structural and fabricating plants, there is quite a shortage in certain sections and sizes. This is, no doubt, partly due to the small demand for the sections and the cost for change-over to roll the section. I have been told that various steel mills are planning a consolidation of certain sections and sizes which may have to be considered later. I understand the steel mill in the area is planning extensive enlargements to take care of other diversified products.

To cope with the various changes that are taking place, there seems to be a great desire in all industries to have their metallurgists, engineers and workmen take advantage of the educational courses that are now being offered by the schools, colleges, universities and through the American Society for Metals.

* * * * *

More high-speed production lines appear in the West

By

BERT W. DEPEW

Chairman, Golden Gate Chapter
Industrial Heating Specialist
Apparatus Sales Division
General Electric Co.
San Francisco

DURING 1951 some of the defense projects in the Western metals industries progressed to the production stage, and more new plants and production lines will be ready in 1952. The importance of metals in this production of defense materials is eloquently portrayed by the many ads "Metallurgist Wanted"!

Defense contracts for some items call for quantities larger than we have produced in our peacetime activities. Therefore, we may say that the new trends in our metals fabrication is in high speed production lines. The various plants producing projectiles and cartridge cases are a good example of this large volume operation. An important development in aircraft fabrication is that of machining structures such as wings out of a solid material, eliminating the complicated and costly process of riveting together many smaller parts.

The ingenuity of the metal fabricators has been demonstrated in the substitution of less critical alloys for some of our more popular materials—for example use of straight chrome stainless in place of the nickel-bearing alloys. The pioneering done by several Western fabricators in the use of ceramic coated parts for high temperature service on aircraft should conserve large amounts of critical alloying elements during the defense emergency. It may prove even

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more valuable on other applications in future years. The boron steels may well answer some fabricators' need for a substitute steel.

Western fabricators feel a need for more knowledge on the interchangeability of steels. To serve this need, the Golden Gate Chapter of American Society for Metals has invited Porter R. Wray, of United States Steel Company to give its Spring Lecture Series on the topic "Alloy Steels." We expect that these lectures will prove very valuable to our Bay Area metals fabricators.

* * * * *

Needed: More Western heavy fabrication plants

By

L. J. BARKER
Chairman, Inland Empire Chapter
Metallurgical Research Laboratory
Kaiser Alminum &
Chemical Corporation
Spokane

PROBABLY the greatest expansion of the metals field in the Northwest is in the production of aluminum. This gives rise to interesting speculation concerning aluminum fabrication possibilities in this area and in the West at large.

As the Coulee Dam irrigation project gets under way and numerous homes, farms and villages are added to this area, two types of markets for aluminum products will be expanded. For irrigation purposes there will be needed vast quantities of tubing and pipe, which can be extruded or roll-formed and welded, and couplings, which can be made of sand or permanent mold castings. The construction of new homes, farms and stores will increase the demand for aluminum screen, siding, roofing, window frames and other related roll-formed products. All of these items could be fabricated in the Northwest.

In the general fabricating picture, novel uses of aluminum foil are being developed, such as disposable food containers and liners of various kinds, laminated vessels and insulative materials, etc., which call for new manufacturing wrinkles.

The transportation industry is going ahead strongly with aluminum. The fabrication of tank trucks and bulk carriers for aluminum will expand greatly in the near future—reducing weight and increasing pay loads.

In aircraft, the trend is toward larger and heavier planes. Likewise, the trend in fabricating aluminum for aircraft is toward larger and heavier products. Sheet is being rolled wider, longer and thicker. Gigantic forging and extrusion presses are in the design stage which will turn out huge, single-unit parts heretofore assembled from multitudes of small ones.

Since a large portion of the country's aircraft plants are Western, it would be logical to locate an equally large portion of this heavy fabrication in the West. Along this same line, I believe Western companies should be ever ready to develop and maintain their share of heavy industry instead of letting it fall to the East and Mid-west.

* * * * *

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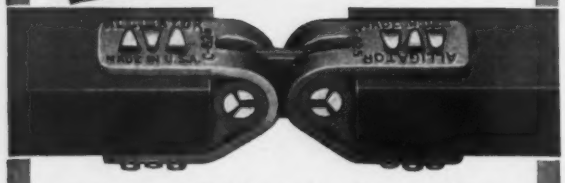

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Boron steels show promise

By

LAIRD GALE
Chairman, San Diego Chapter
Superintendent
Industrial Laboratory
U. S. Naval Station
San Diego

THE PRESENT national emergency has again brought to the fore the necessity for the conservation of strategic materials, as nickel, chromium, vanadium, molybdenum, etc.

During World War II this condition existed and was met by developing the NE (Nation Emergency) steels, many of which are today used in regular production. This problem is so important that the U. S. Navy has requested the National President of the ASM to form an advisory committee to consult and recommend new substitutes for these strategic materials.

This problem of substitution has been met in the San Diego area by the Research Staff of Solar Aircraft Company, who manufacture aircraft components, jet engine parts and turbine blades, by the development of a ceramic material which is coated on less strategic material and used for high temperature work.

This material is not of general use in fabrication mate-

rials and therefore the boron steels offer an important substitute for the standard structural steels. The American Iron and Steel Institute has developed lists of an interim alternate steel designated to conserve nickel or molybdenum.

They apply to hot rolled alloyed steels in general. An interesting point about boron steels is the potent effects of minute amounts of this alloy. As little as 0.001% boron has a very marked effect on the hardenability and maintenance of high mechanical properties. 80 BXX boron steels will match the hardenability of the NE 86XX-87XX series and the 81BXX will match the 41XX.

In addition, these series will reduce by half the critical alloying content of the 8600 and 8700 series. The 94B17 and 94B20 boron steels show very promising possibilities for carburizing parts formerly made of 4620; 43B17 and 46B20 show promise for carburized parts of heavy duty trucks; 86B45 is a possible replacement for 4340; 50BXX is used to replace 36XX for some tractor applications.

Some additional advantages of boron steels are: (1) improved hot and cold working, (2) shorter annealing cycle, (3) improved machinability, which will result in economies.

Care must be used in selecting boron steels because:

1. Boron cannot perform the same function as does molybdenum, vanadium or tungsten in contributing to strength at elevated temperatures;
2. Boron exerts a pronounced effect on hardening properties but little or no effect on retarding softness at elevated temperatures;
3. Hardenability must be adequate where the highest stresses are encountered. If the condition is not met, mechanical properties, particularly toughness, may be impaired to an even greater extent than in the conventional steels;
4. Because of this decreased hardenability effect due to boron a slightly higher alloy content and lower carbon content should be carried.

As more and more metal fabrication industries move into the Southwest, this problem of substitution and working of these alloys will assume greater importance and it will be the duty of technical men and societies to educate these fabricators in new techniques.

This can and is being done by conducting educational programs for shop men. The San Diego chapter is conducting a spring educational program wherein modern trends and forming will be stressed. It is only by bringing before these fabricators the results of modern research that the use of substitutes for strategic materials will be accomplished.

* * * * *

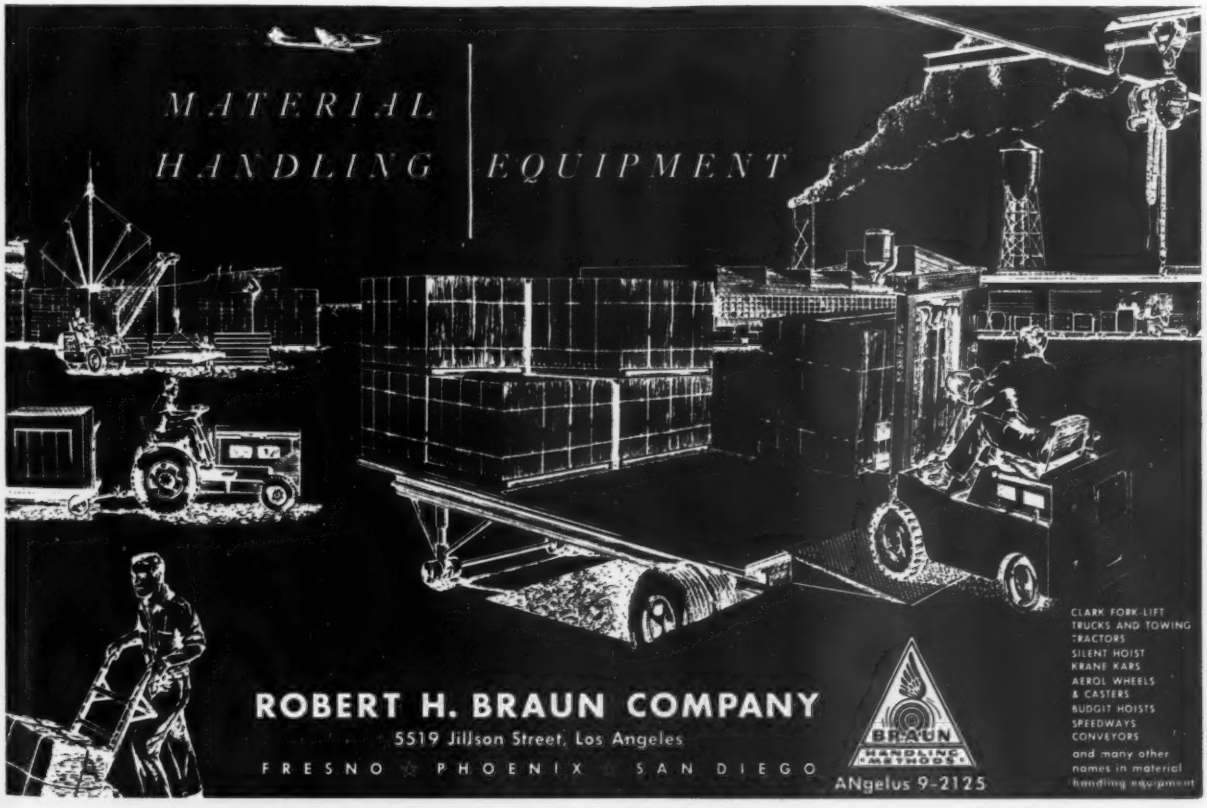
Western manufacturers closing the gap on Eastern competition

By

E. T. CARLSON

Chairman, Puget Sound Chapter
Sales Representative
U. S. Steel Supply Division
U. S. Steel Company
Seattle

THE FUTURE of metal and the metalworking industry of the West within the next few months or years is one in which we will be competing with the Eastern manu-



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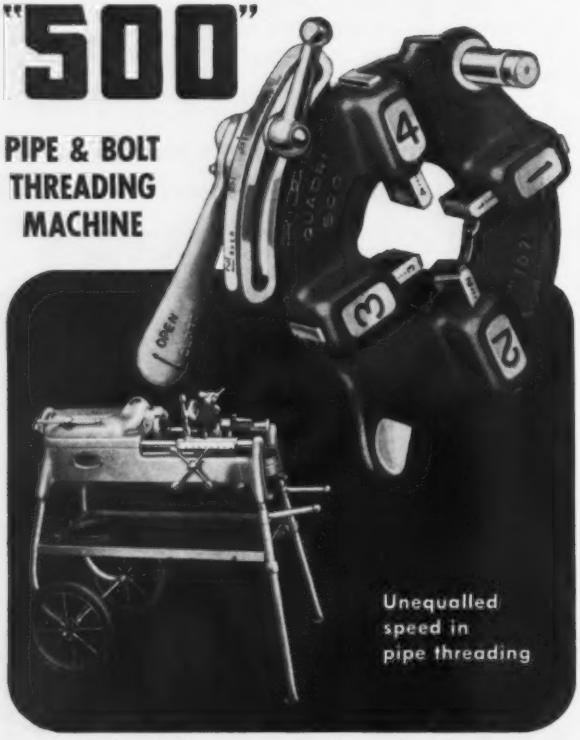

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facturing area of the United States in everything that is made of and by metal. The tremendous possibilities of the use of atomic energy for industry and the further hydro-electric potential will greatly help to make this industrial expansion possible.

At the present time, however, the continued decrease in the civilian use of metals will retard the development of new products. It appears that this condition will continue through 1952 or at least as long as the defense program continues.

Substitution seems to be the byword for the fabricators—structural steel and plate fabricators in particular. This, however, has developed many new methods of design, both as to structures and to machinery.

New metals and new uses for metals are also being caused by the necessity of substitution. The alloying of nitrogen (a gas) to stainless steel to stabilize it is a good example. High strength low alloy steel plate for fishing

Welding bids to replace riveting and cut cost of metal fabrication

Westerners might adopt Eastern methods of cost evaluation, and become more competitive

THERE IS A DEFINITE TREND toward welding replacing riveting. This development appears to be well established in the fabrication of storage tanks, pressure vessels and other types of code tanks.

ASME and API-ASME codes covering pressure vessels as well as AWS rules for field welding of steel storage tanks and AWS-AWWA standard specifications for elevated steel water tanks, stand pipes, etc., guarantee a means of assuring fusion welded vessels safe to operate. This lower cost type of fabrication has practically eliminated construction of riveted vessels.

A growing trend toward welding in ships, structures and bridges, is evident. It is interesting to observe results of comparative bidding between welding and riveting fabricators, particularly on structural projects. Weight reduction, material savings, flexibility of design, improved appearance, added strength and finally lower cost of fabrication, favor the bidder specifying welded design.

Likewise, weldments are rapidly replacing many types of composite structures.

In general, fabricating methods have shown marked progress in recent years. Development in better forming methods, cutting, fit-up, assembly and positioning, together with remarkable advancement of automatic welding, have resulted in improved design and lower cost manufacturing.

The trend toward replacing concrete and wood structures with steel has become common practice in the construction of buildings, bridges and stadiums. Likewise low alloy high tensile strength steels, and many non-ferrous metals are replacing steel for the advantages they possess in greater strength, corrosion resisting properties and weight reduction.

Metals which show greatest promise of future development are:

and small boat hulls is being used.

The use of Type 430 stainless steel in lieu of Type 302 very likely may show the greatest promise of future development. Type 302 in varied hardness is being greatly demanded by the aircraft industry, and it seems very possible the government will find it necessary to limit even further the use of not only 302 but also all types of stainless steel except Type 430.

Aluminum seems to still be in greatest demand, particularly by the aircraft and truck manufacturing industry. However, it is observed that the common carbon steels such as structural shapes, mild steel plate and allied products are still in the greatest demand.

Fabricators need a knowledge, or at least a working understanding, of basic design principles involving the strength of materials, heat treating and the heat-treatability of metals. This is necessary again because of the necessity of the substitution of all types of metals.

By

EDWARD H. WEIL

Chairman, Portland Section
American Welding Society
District Manager
Lincoln Electric Company
Portland

1. Aluminum and magnesium alloys which now can be successfully fabricated by the use of inert-gas welding.
2. Facilities for production of ductile titanium and its alloys are rapidly developing. The aircraft industry in particular is interested in this metal because of its strength-weight ratio, its intermediate temperature properties and its resistance to corrosion. This material lends itself readily to welding by the inert-gas process.
3. Zirconium is another metal of the strong, light weight group with high corrosion resisting qualities, attracting much attention. In some applications this metal is equal to pure platinum.
4. The many classifications of stainless steels and stainless clads are finding new uses in practically every field.

The cost of titanium and its alloys and Zirconium is almost prohibitive at the present time. Improved methods of producing these metals with a consequential reduction in cost, will undoubtedly lead to increased demand.

It is my opinion that the average Western fabricator is still not "cost conscious." He designs for results rather than cost. He worries only about meeting competitive prices rather than analyzing his fabricating methods and lowering his costs.

In contrast to this, the Eastern fabricator is in the position to benefit by a better exchange of ideas and procedures because of concentration of industry. The size of Eastern industry permits greater expenditures and experimentation.

Education, along the lines of development in automatic procedures, improved methods in forming, cutting, fit-up, assembly and positioning, will bring surprising results.

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301

Tool Steel Handbook, 197 Pages

A concise, 197-page "Tool Steel Handbook," published by *Allegheny-Ludlum Steel Corp.*, presents a complete picture of the properties, types and applications of tool steels produced by that firm.

Volume begins with charts and tables giving specific and comparative data on properties, analyses and applications. This is followed by detailed descriptions of all important grades. Later chapters deal with the many forms and finishes of tool and die steels and such allied products as the sintered carbides marketed by Allegheny. Final sections are comprised of extensive discussions of heat treating and handling techniques as applied to tool and high speed steels and a complete set of weight tables.

This manual, intended as companion literature to previously published "Stainless Steel Handbook," should be of infinite value to engineers, teachers, metallurgists and others interested in tool, die and allied steels.

302

Literature on Tap Grinding Machines

Carl Hirschmann Co. makes available a pamphlet on equipment manufactured by *Meteor, Ltd.*, Zurich, Switzerland, for converting twist drill grinders so that they will sharpen the tapered start of all the usual taps for right-hand and left-hand threads.

303

Case Studies on Abrasive-Belt Machines

A number of case studies are used to illustrate abrasive-belt machines in a basic manual on this subject prepared by *The Porter-Cable Machine Co.* General terms and specifications are given.

304

A Guide for Specifiers of Aircraft Rivets

The Milford Rivet & Machine Co. has for design and production engineers, purchasing officials and plant operating executives a complete design chart to indicate styles of rivets and simple-to-use tables of sizes, weights, and quantities to facilitate specification of aircraft rivet needs.

305

Diagnosing Mechanical Troubles

American Name Plate & Manufacturing Co. publishes a new piece of literature on its electronic stethoscope designed to locate and diagnose mechanical troubles that delay production.

306

A Directory of Low Temperature Welding Alloys

Photographs, data and technical information on a series of low temperature welding alloys for use on cast iron, steel, alloy steels, copper, brass, bronze, aluminum, magnesium, hard and machinable overlays, are contained in a new booklet available from *Eutectic Welding Alloys Corp.* Of special interest is a two-page chart devoted to a list of over 100 different welding alloys, their main uses, bonding temperatures and tensile strengths.

307

Here's "Know-How" for Production People

"Production Control Systems and Procedures," published by *Remington Rand Inc.*, outlines a unique method of materials control for speeding production by eliminating the causes of various delays on production lines.

This brochure is fully illustrated with typical forms and procedure charts. It describes procedures for engineering, production planning and progress, machine loads, material and tool procurement and control. Included is a typical case history which reviews an installation that has been in successful operation for several years.

308

Measuring Cam Contours

F. T. Griswold Mfg. Co., 305 Lancaster Ave., Wayne, Pa., offers you, through our reader service, a bulletin on gauging systems developed to measure cam contours, both angle and amount of eccentricity, by direct reading optical means.

309

Facts About Zinc

"Facts About Zinc," published by *American Zinc Institute*, 60 East 42nd St., New York 17, is just what you need to answer all your questions about this vital metal. Order by above key number.

310

Automatic Roll Marker Bulletin

Information on an automatic roll marker for screw machines may be obtained from *New Method Steel Stamps, Inc.*, which includes instructions for operation, setup, use of offset dies, correct location of starting pad, ordering markers or dies.

311

Elmes Presses Cataloged

Complete line of straightening and forcing presses manufactured by *Elmes Engineering Division of American Steel Foundries* is described in two new bulletins available from that company.

312

Bandtooling Booklet

The DoAll Co. publishes a brochure explaining its hydraulically operated bandtooled machine, the Contour-matic. Included are illustrations of the types of bandtools designed for this machine, and attachments that adapt the machine to specific production jobs. Booklet also covers conventional sawing, high speed sawing, friction cutting, bandfiling and polishing, vertical line grinding and diamond sawing performance.

313

All About Wrought Copper Alloys

Chase Brass & Copper Co. is making available a handbook containing data on the more common and useful wrought copper alloys which it markets.

For each alloy it gives the name most commonly used together with other names sometimes applied. Nominal composition of the alloy, forms in which it is available, physical properties for a variety of tempers, and typical uses are among the other data given. Tensile strength, elongation and hardness are also given for each alloy.

314

Lift Truck Manual

Bulletin 5143 describes with full specifications, illustrations and drawings, four compact "walkie" units designed for lifting, moving and stacking heavy loads with minimum labor expenditure. Published by *Barrett-Cravens Co.*, 4609 S. Western Blvd., Chicago, Ill. Order through our reader service.

315

Something Will Develop

when you send for *Peck & Harvey's* bulletin which gives helpful facts about the whiteprinting process and important suggestions about printing and developing for speed, economy and utility. Our reader service can secure this one for you.

316

Multi-Purpose Face Grinders

A complete cataloging of the full line of radial head face grinders manufactured by *Besly-Welles Corp.* is now obtainable. Complete specifications and examples of cost-cutting grinder applications are provided.

317

Heavy Duty Knife and Face Grinders

Samuel C. Rogers & Co. has prepared a new bulletin on its massive high production series of heavy duty knife grinders. Booklet is fully illustrated with cuts showing the grind, adaptations and features of these grinders.

318

Collet Chuck Info

An eight-page catalog describing *Sutton Tool Co.'s* levermatic collet chuck is available to you through our reader service. This piece of literature gives cross-section views and shows a number of standard and special applications.

319

Film Type Heating

Why not read *Electrofilm Corp.'s* booklet on film type heating elements. This brochure covers uses, methods of application, mechanical, thermal and electrical characteristics of the electrofilm type heating element. You'll be warmed by the story of this electrically conductive plastic that provides uniform heat distribution and maximum heat transfer.

320

Pydraul F-9 Specifications

A 12-page booklet describing in detail the properties and performance of Pydraul F-9, *Monsanto Chemical Co.'s* inflammable-type hydraulic fluid is available from that company or through our reader service.

MORE LITERATURE, PAGE 116

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STEEL STATISTICS—

STEEL (INGOTS AND STEEL FOR CASTINGS)

As of January, 1951. Source: American Iron and Steel Institute

	OPEN HEARTH		ELECTRIC AND CRUCIBLE		
	No.	Annual Capacity (Net Tons)	No.	Annual Capacity (Net Tons)	Total Annual Capacity (Net Tons)
CALIFORNIA					
Emeryville—Judson Steel Corp.	3	76,500			76,000
Fontana—Kaiser Steel Corp.	7	1,200,000			1,200,000
Los Angeles—					
Bethlehem Pacific Coast Steel Corp.	3	84,000	2	240,000	324,000
Southwest Steel Rolling Mills			1	36,000	36,000
Niles—Pacific States Steel Corp.	2	140,000	2	91,300	231,300
Pittsburg—Columbia Steel Co.	7	364,700			364,700
South San Francisco—					
Bethlehem Pacific Coast Steel Corp.	5	240,000			240,000
Torrance—Columbia Steel Co.	4	201,700	1	12,000	213,700
National Supply Co.			3	50,400	50,400
Total California	31	2,306,900	9	429,700	2,736,600
COLORADO					
Pueblo—Colorado Fuel and Iron Corp.	16	1,320,000			1,320,000
OREGON					
Portland—Oregon Steel Mills			3	110,000	110,000
UTAH					
Geneva—Geneva Steel Co.	9	1,440,000			1,440,000
WASHINGTON					
Seattle—					
Bethlehem Pacific Coast Steel Corp.	5	216,000			216,000
Isaacson Iron Works			2	101,520	101,520
Northwest Steel Rolling Mills, Inc.			1	32,400	32,400
Total Washington	5	216,000	3	133,920	349,920
GRAND TOTAL	61	4,282,900	15	673,620	5,956,520

WIRE AND WIRE PRODUCTS

As of January, 1951. Source: American Iron and Steel Institute

	ANNUAL CAPACITY, NET TONS					
COMPANIES	Plain Wire	Galvanized Wire	Nails and Staples	Barbed Wire	Woven Fence	Bale Ties
Bethlehem Pacific Coast Steel	42,000	.....	.....	.....	.....	.....
Johnson Steel & Wire Co.	6,000	.....	.....	.....	.....	.....
Colorado Fuel & Iron Corp.	155,000	68,500	54,000	32,400	18,000	21,700
California Wire Cloth Corp.	43,200	.....	.....	3,700	.....	2,700
Columbia Steel Company	123,950	27,230	53,870	4,190	7,660	3,450
K. H. Davis Wire & Cable Corp.	12,000	1,200	.....	.....	.....	600
National Standard Co.	1,000	300	.....	.....	.....	.....
Total	383,150	97,230	107,870	40,290	25,660	28,450
STATES						
California	228,150	28,730	53,870	7,890	7,660	6,750
Colorado	155,000	68,500	54,000	32,400	18,000	21,700
Total	383,150	97,230	107,870	40,290	25,660	28,450

RAILS, JOINT OR SPLICE BARS AND TIE PLATES, TRACK SPIKES

As of January, 1951. Source: American Iron and Steel Institute

	ANNUAL CAPACITY (Net Tons)			
	Rails		Joint or Splice Bars and Tie Plates	Track Spikes
COMPANIES	60 lbs. or less/yard	Standard (Over 60 lbs. per yard)		
Colorado Fuel & Iron Corporation	9,600	420,000	144,000	30,000
Columbia Steel Co.	.....	.....	73,870	.....
Bethlehem Pacific Coast Steel Corp.	.....	.....	12,000	6,000
Total	9,600	420,000	229,870	36,000
STATES				
California	.....	.....	73,870	1,000
Colorado	9,600	420,000	144,000	30,000
Washington	.....	.....	12,000	5,000
Total	9,600	420,000	229,870	36,000

MORE HELPFUL LITERATURE

321

Jig and Fixture Components

Fully described in a catalog by *Jergens Tool Specialty Co.* are more than 375 key-note samples of component parts manufactured by that company. In addition, hand-wheels, lever knobs, clamp assemblies, chuck jaw blanks and sine fixture keys, manufactured by that company are described.

322

Design Details on Press Brakes

A catalog issued by *Verson Allsteel Press Co.* gives design details and specifications on a complete line of press brakes with capacities from 15 tons up. Both mechanical and hydraulic types are covered.

323

Engineering Services Suggested

The engineering services offered by *York Engineering & Construction Co.*, 951 Penn Ave., Pittsburgh 22, Pa., are described in a four-page folder just published. Services include design of buildings, foundations and equipment for industrial plants, as well as project coordination and control.

324

Plymouth Locomotive Catalog

Plymouth Locomotive Works Division of *The Fate-Root-Heath Co.*, has just published a catalog giving specifications on its complete line of 3-ton to 70-ton Plymouth industrial switches. Send for your copy through our reader service.

325

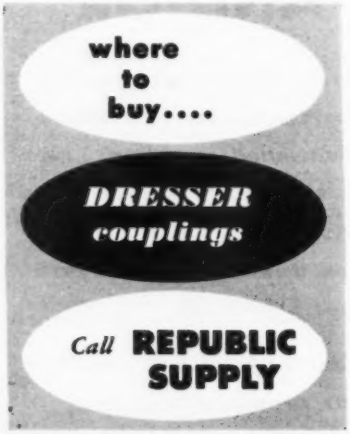
Economy Tips on Punches

"How to Save Money on Punches and Dies" is title of a 16-page bulletin published by the *F. J. Stokes Machine Co.*, 5500 Tabor Road, Philadelphia, Pa. It gives a broad summary of ways and means for keeping punches and dies in condition to do best work at highest efficiency.

326

Time Saving Die Set Features

"Save Tooling Time," published by *Danly Machine Specialties, Inc.*, discusses in detail all four major factors involved in die set convenience and efficiency. It presents tooling advantages in both time and cost reductions.



327

Honeywell Publishes Instrument Catalog

Minneapolis-Honeywell Regulator Co., Philadelphia, offers our readers a catalog describing its complete line of control devices and related components.

328

Pickup Manual Available

Consolidated Engineering Corp.'s new brochure will answer your critical application questions regarding amplitude and accelerations, frequencies, nature of motion and range of temperature. Yours for the asking through our reader service.

329

Hot Form Tubing Details

A new four-page folder, titled "Machine Hot-Forms Tubing Into Complex Parts," is available from *Tube Reducing Corp.*, Wallington, N. J., through our reader service.

330

Regulator Valve Booklet

Bulletin 700, issued by *Spence Engineering Co., Inc.*, Walden, N. Y., features a large cutaway illustration of a typical Spence pilot-operated regulating valve with detailed explanations of five design features. Get this one through our reader service.

331

News on Hard-Facing

A new line of hard-facing electrodes and acetylene welding rods is fully described in literature published by *Metal & Thermit Corp.*, producer of this line.

332

Goodrich Tells How to Size Nylon

A processing size for nylon which is characterized by superior abrasion resistance and outstanding adhesion to nylon, and which is manufactured by *Goodrich Chemical Co.* is described in a new four-page bulletin published by that company.

333

About Liquid Relief Valves

An OEM folder available from *Kunkle Valve Co.*, 128 S. Clinton St., Fort Wayne, Ind., through our reader service, illustrates air, gas, steam and liquid relief valves for original equipment application. Send for your copy.

335

Don't Be Fussed About Rust

You won't have to be if you send for rust preventive use chart No. 1151, published by *Nox-Rust Chemical Corp.*, 2429 South Halsted St., Chicago. Order it by above key number.

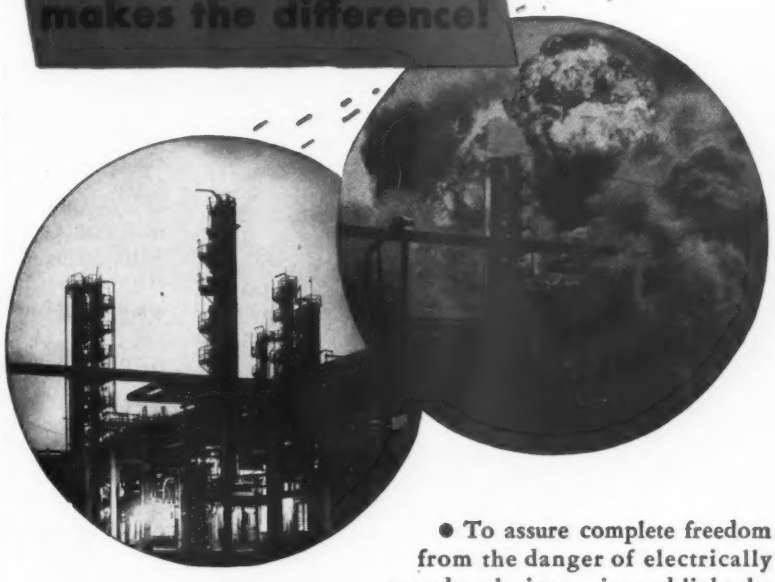
334

For Speedy Drives

is this *Metron Instrument Co.*, technical data sheet No. M1 which describes miniature combination fixed and variable speed rivets for use in low power applications requiring variable speed at a reduced nominal output speed.

OBTAIN YOUR FREE COPIES of valuable reference booklets described above by using coupon on page 115. Write in key numbers for those you want.

One Spark— makes the difference!



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NEW MATERIALS & EQUIPMENT

COUPON ON PAGE 115 provides an easy way to obtain more information on products introduced.

336

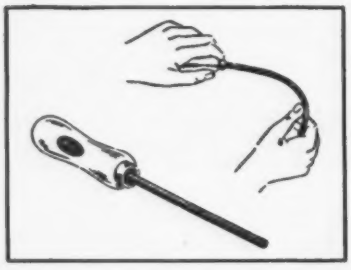
Bench-Type Precision Grinder with Magnetic Chuck

A bench-type precision surface grinder, manufactured by *Viking Industries*, features an extra heavy head stock, micrometer adjusting dials, precision spindle with heavy duty ball bearings, that assure fast precision work on small parts. Also included as standard equipment is a magnetic chuck. Machine is powered by a 1/3-hp., continuous duty dual-voltage motor, and is designed for mounting a 4 in. diameter wheel. It can easily be converted to a milling machine or bench lathe with simple attachments. Interchangeable pulleys make it possible to obtain wide range of speeds up to 7,000 rpm. An adjustable pilot light is mounted on base of machine. Size of base is 11 x 18 in. Table working surface is 9½ x 6 in. Surface size of magnetic chuck is 3⅝ x 3⅛ in. Overall height of chuck is 1-5/16 in. A convenient unit with switch for demagnetizing can also be provided. Table is mounted on an unusually rugged dovetail way, and is quickly and easily traversed by hand lever. New-type micrometer dials for vertical and cross feed adjustments are graduated in .001 in., permitting fine settings.

337

This File Bends to Fit Your Job

This soft core, parallel round file can be bent cold to almost any shape you want. It will not clog on the softest materials — even lead. Ideal for cleaning concave surfaces, model work, cleaning awkward corners in pipe bends and castings and other hard to reach areas. It cuts all metals from steel to lead; all wood, hard, soft and ply; all plastics and marble. Manufacturer of this product is *Drilsaw Co.*



338

Collet Chuck with Handle

A hand-collet-chuck, manufactured by *Spring Specialties Co.*, consists of a strong wooden handle with a fixed ¼-in. collet chuck. Handle is shaped to fit comfortably into palm of hand, is impregnated with shellac and is smoothly lacquered. Collet chuck is made of selected steel and is rigidly anchored, pinned and ferruled to handle. It is designed to hold such tools as rotary files, mounted points, abrasive discs, polishing buffs and felts, as well as all types of screw drivers, hand nut setters and scrapers and special tools fashioned for specific jobs, with round shanks of ¼, 3/16, ⅛ or 3/32-in. diameters. Three smaller sizes are accommodated by use of inserted reducing collets which are provided with tool.

339

Drill Press Attachment Makes Springs

Features claimed: With this simple attachment it is possible to wind springs on a standard drill press instead of resorting to cumbersome and time-consuming lathe setups. It can be applied to any drill press with a ½-in. chuck or larger, and springs in a wide range of wire sizes and diameters can be made at high speed. It takes only a few minutes to attach Spring-Master to drill press, make adjustments for spring size and be in production, forming precision springs. One operator can operate two or more machines, since no further attention is required after set-up, except for replacement of wire spools. An unlimited variety of extension and compression springs can be produced on this model. It is possible to wind wire diameters from No. 8 ga. (.020 in.) to No. 28 ga. (.071 in.) and outside diameter of finished springs can be made to vary from 3/16 to ⅝ in. Pitch of a compression spring may be infinitely varied while machine is running. Built-in adjustable wire guide for use in manufacture of extension springs provides for increase in tension of wire to degree required to give completed spring maximum efficiency in operation.

Available from: The DoAll Co.

340

Cutting Fluids for Tough Machining Operations

Cutting fluids, manufactured by *Magnus Chemical Co., Inc.*, are designed for tough machining operations such as work on stainless steel, high carbon steels and other difficult machining metals where general purpose cutting fluids cause excessive wear and poor surface finishes. These fluids are economical because of their sulphur base content. Cutting compound No. 7 undiluted, for example, is recommended for unusually difficult machining operations. Where staining of copper is to be avoided, No. 6 is recommended. For difficult machining jobs where greater cooling qualities are needed, Magnus soluble oils DO-4A and DO-1A are recommended. These give good rust protection and minimize occurrence of rancidity and dermatitis. They do not gum up in service.

341

Sturdy Stool Has Adjustable Legs

Here is a stool with a spring action backrest right where it is needed to relieve tired backs. Other features include a thick seat, curved to fit body, and strong steel legs rigidly braced at bottom. Legs are adjustable and can be raised or lowered an inch at a time. Stool is constructed of splinterproof, highly polished hardwood and strong angle steel, rigidly braced and cross-braced, making for a sturdy, resilient unit which will take plenty of banging around. Manufacturer is *McKinley Equipment Co.*

342

Floor Flourishing

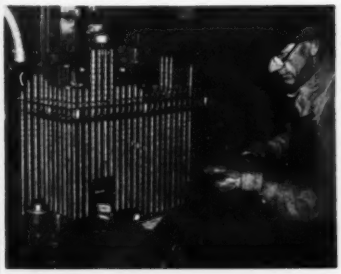
Features claimed: Roc-Wood is a flooring material composed of hardwood fibers chemically treated and bonded together with a plastic binder. Combination of wood, chemical and plastic results in a smooth, skid-proof, practically indestructible floor surface. It binds itself permanently to almost any sub-structure without costly underlayments. It can be laid with a trowel, using pre-mixed ingredients and hardens by chemical action (not by evaporation), and is ready for use in 24 hours. It resembles cork flooring, wears longer and better than concrete and has a resiliency that

SAVE THOSE FINGERS!

WITH AN

M & D Punch Press Guard

Operators Will Use This Guard Because . . .



- Designed and built by punch press engineers and operators.
- Provides maximum safety.
- Simple and flexible.
- No nuts, bolts or screws.
- Guard easily removable from press for changing dies.
- Pins adjustable vertically and horizontally to form desired barrier.
- Openings in guard can be arranged for ejection of parts or insertion of material.
- Guard stationary—Does not move with ram.

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For Conveying Under Pressure or Vacuum

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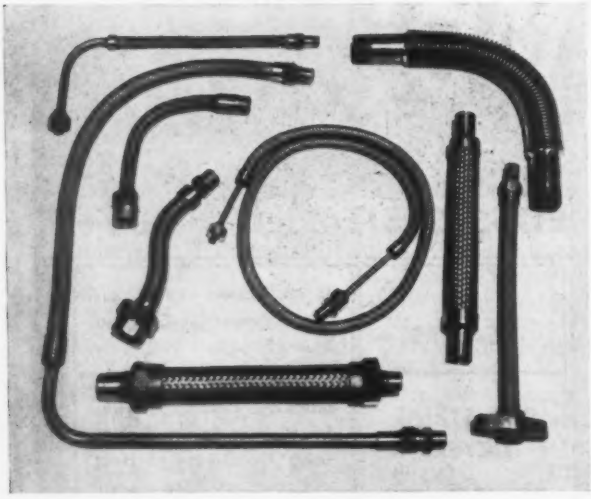
Assemblies manufactured to your requirements. Special or standard fittings available to fit your connections.



Johnson flexible metal hose is manufactured from a seamless tube without joints —seams—or welds. Available in bronze, carbon steel and stainless steel.

Fittings are welded to ends for high or low temperature applications.

Write for Bulletin J-3.

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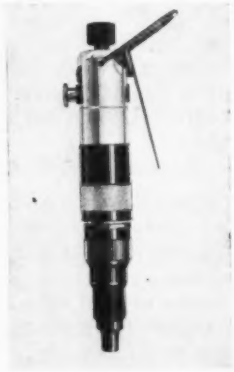
reduces standing and walking fatigue to a minimum. Other advantages include: withstanding vibrations; staying smooth and crack free; being resilient, easy to walk upon, skid proof, termite and rot proof, as well as acid and chemical resistant.

Available from: Roc-Wood Flooring.

343

Air-Powered Screwdriver

Features claimed: This air-powered screw driver and nut setter is designed with a push-button control which provides instantaneous reverse action. Tool's push-button valve introduces a new concept of rapid change from forward action in screw driving and nut setting. Operator merely presses a button on tool and instantly action is reversed. When forward motion is again desired, operator removes his thumb from button which is spring-released. In either case, tool need not be removed from work and no time is required for adjustment. Operator always has one hand free, to handle screws. Tool has an adjustable clutch which can be pre-set to correct torque requirements. Clutch jaws automatically disengage when screw is set to desired tension. Also available with positive clutch. Tool combines lightness and speed with power and endurance. It is designed for continuous high-speed production, having a speed of 1,800 rpm. and built-in speed regulator.



Occupational Dermatoses Cost You Money!

It's important to prevent the danger of skin rashes suffered by factory workers because industrial dermatoses mean lost man-hours and higher insurance premiums.

Triple-acting Vanfaire Lotion effectively guards against allergic or "sensitization" skin rashes in handling metals, lacquers, solvents, plastics, cutting oils and other sensitizing materials...antiseptically aids healing of minor scratches and abrasions . . . conditions and softens skin. Vanfaire Dispensers for plant washrooms provide Vanfaire Lotion at an average month's investment of 15c per employee. Workers *like* its mild scent and quick-drying, greaseless efficiency and appreciate management's consideration.

Available in gallons for dispenser use, small bottles for individual use. Write for technical bulletins and testing samples on your letterhead.

STEWARD-DAVIS, (aircraft maintenance company) states: ". . . it has eliminated any signs of dermatoses on the hands of employees in the cleanup and in any area where they are using solvents, caustic soda, and cresylic acid...no problem getting personnel to use it, as they have discovered the advantages."

Vanfaire Products
3757 Wilshire Blvd.
Los Angeles 5, Calif.

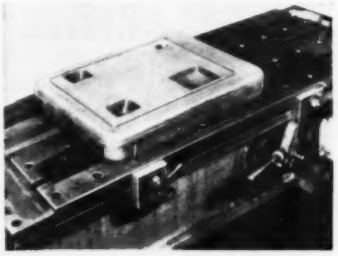
It can be quickly converted for nut-setting. Overall length, 7-11/16 in. Outside diameter 1-5/16 in. Weight 1.4 lb.

Available from: Aro Equipment Corp.

344

Jaw Clamps Designed for Larger Planers

Clamps designed for larger-type planers, with many times the power of ordinary finger set-ups, produced by *J & S Tool Co.*, allow loading and unloading by simply loosening one adjusting screw. These clamps, called "Lil-Giant" and "Jumbo," employ a principle of securing work-pieces rigidly to any machine tool. In jaw clamps, jaw travels in and down, at a 45-deg. angle, forcing work-piece horizontally against opposite clamp, and downward against table. On adjusting screw positions and holds, work-piece with clamp always remains in same position. Controlled centering is quick and simple. In production runs, half of clamps can be left in position while others are used for loading and unloading. Clamps are completely hardened throughout. Elongated slot has a back taper which prevents slippage. All are equipped with T-nuts to fit all large standard planers and with varying nose-grips for special requirements.



Use coupon, page 115, for more information

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SAN FRANCISCO 3 • LOS ANGELES 37

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Everything you want...

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Special Sections

simplify production, cut waste, reduce costs *and do a better job.* These continuous rolled metal shapes and tubing include LOCK SEAM, TIGHT BUTTED, OPEN SEAM, WELDED TUBING and standard or special formed shapes *to your size and design.* Have *you* a *special* production problem?

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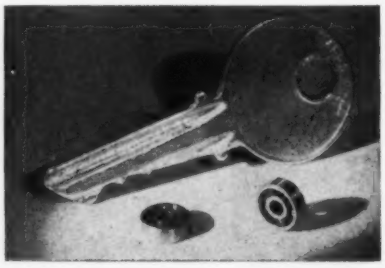
PIPE • STEEL • TUBING

345

Spring-Retainer Miniature Bearing

A miniature spring-retainer ball bearing, produced by *New Hampshire Ball Bearings, Inc.*, has individual stainless steel coil spring separators which permit balls to creep relative to each other, thus avoiding jamming up and sliding friction effects found in rigid separators in critical friction applications such as synchros, gimbals, etc. This type is a more consistent performer than conventional Conrad (retainer) design in the factor of starting or breakaway torque. Under a standardized 70-gram thrust load, a high percentage fall in the range .0006 inch-oz. or lower, with good repetitive readings.



346

Automatic Scrap Baler

A machine, manufactured by *Wheeling Steel Corp.*, will produce bales of steel scrap that are more uniform in size and weight and of a much greater density than heretofore possible. In fact, this unit compresses steel scrap to a density of from 45% to 70%, depending on type of scrap on hand. Loose scrap fed into baler box (90 in. long, 48 in. wide and 30 in. deep) is crushed and squeezed into approximately an 18-in. square block weighing between 600 and

STEEL Stanho PRODUCTS

MACHINE KEYS

ALL TYPES

Woodruff Keys Machine Rack
Taper Pins • Straight Pins
Cotter Pins and Other
"Stanho" Steel Products

PRECISION ACCURACY

M-2

STANDARD HORSE NAIL CORP

NEW BRIGHTON, PA

West Coast Representatives
GRETHER & GRETHER, P. O. Box 532, Stockton, California

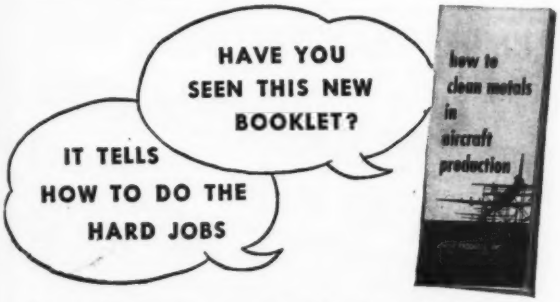
1,000 lb. Three hydraulically-operated rams, developing 225 tons, 400 tons and 750 tons of pressure respectively, quickly transform a tangled mass of sheet steel trimmings into a highly compact and easy-to-handle block of scrap. A fourth ram exerting a pressure of 50 tons opens and closes the baler box, the top of which is flush with floor, and pushes bales out of the way. Entire operation from loose scrap to finished bale consumes less than three minutes.

347

Steel Ramp Expedites Loading, Unloading

Simplified engineering design of this steel truck loading ramp makes it adaptable in speeding-up truck loading and unloading operations to cut time labor performance. It is easily placed in position, removed and transported by one man and meets every safety factor. Ramp accommodates trucks that are either higher or lower than dock level with a "ramp stop" that holds it securely in position. It is made of sturdy heavy cut steel safety tread plate, crowned to compensate for height differences, with safety side rails and beveled edges. Sizes are made to meet all trucking needs from 48 in. wide and 36 in. long, to 48 in. wide and 72 in. long, with a capacity range from 4,000 to 8,000 lb. Manufacturer is *Penco Engineering Co.*

Use coupon, page 115, for more information



Better cleaning cuts costs in aircraft production. This 48-page illustrated booklet outlines all the big cleaning jobs. Have you seen the latest Oakite recommendations on:

¶ How to clean aluminum before anodizing? *See page 4.*
¶ How to prepare aluminum for spot welding? *See page 10.*
¶ How to prepare aluminum for painting? *See page 15.*
¶ How to clean aluminum before and after heat treating? *See page 20.*
¶ How to strip paint from aluminum? *See page 22.*
¶ How to select and install cleaning tanks, rinse tanks, and spray-washing machines? *See pages 31 to 35.*

FREE For a copy of *"How to clean metals in aircraft production"* write Oakite Products, Inc., 1001 E. First St., Los Angeles, or 681 Market St., San Francisco, Calif.

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Here are four instruments widely used by industry for a large variety of measuring needs . . . highly valued for their accuracy, dependability, and convenience . . . backed by Meriam's 37 years' specialization in the field of measurement.

U-Type Absolute Pressure Gauge

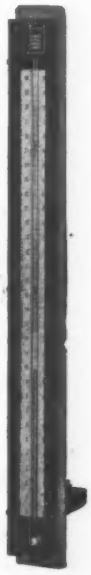
For the measurement of *absolute pressures* from one millimeter of mercury to the equivalent atmospheric pressure. Of simple design—accurate and dependable. Gauge head fastens to body by a single wing nut. Available in wall or flush front mounting styles. Ask for catalog sheet C-1142 WM.

Clean-Out U-Type Manometer
(Model B-1169 WM)

Semi-steel clean-out head is removable from body frame for filling and cleaning U-tube. For line pressures up to 100 lbs. per sq. in. Large bore "pyrex" tubing 7/16" inside diameter gives flat indicating fluid meniscus. Bold ½" high scale numerals provide for distant reading. Ask for catalog sheet B-1169 WM.

Well Type Manometer
(Table Mounting)

For portable service in the field, production testing, or in the laboratory. Glass tubing is gland packed at each end block and is supported at spaced intervals to prevent tube distortion. Also available for wall mounting, pipe mounting, and flush front panel mounting. Ask for catalog sheet A-203 TM.



Well Type Manometer
(Front-of-Board Mounting)

The instrument body channel, scale, and indicating tube mount to the front of the panel; instrument well mounts behind panel. Connections are made behind the mounting panel. Provides an accurate, quick, and direct method of measurement. Ask for catalog sheet A-324 FB.

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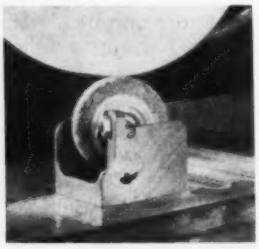
348

Wheel Dresser with Replaceable Parts



This dresser was designed to keep grinding wheel face clean, sharp and cool. All parts are replaceable and can be ordered by number. To change wheel, you just loosen two lock nuts on either side of housing, remove retainer screws and entire assembly can be lifted out. Remove wheel nut and replace with new wheel. Available in two models: one is designed for surface grinding and the other for cylindrical grinding. The latter comes with either a vertical or a horizontal stand. Either dresser will trim any type of wheel. Manufacturer is *L. Newman.*

349

Soldering Cream Gives Corrosion Protection

Fargail soldering cream increases activity of a flux without use of mineral acids while definitely protecting metal soldered from corrosive attack of active ingredients. It gives off no toxic fumes and is buffered to reduce corrosion. It may be used on all operations where soldering paste is indicated. Conductivity on electrical equipment is nil. Also highly effective when used for sweating copper fittings as its scavenging action is so pronounced that solder becomes highly fluid, making for better and tighter joints. Fargial is a product of *Farrelloy Co.*

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350

Quick Connectors Are Safe and Sure

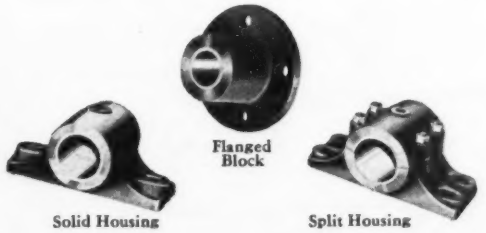
By a simple turn of the fingers, these "quick connectors," manufactured by *Brummel Hook Co.*, instantly attach or detach lines to other lines—wire rope, rope or chain—or to fixed objects. Once they are joined, they cannot come apart until intentionally disconnected. All sizes and types—fast or fixed eye hooks, swivel hooks, fixed jaw hooks, floor or platform fittings, bolt hooks—are made from tough, corrosion resistant manganese bronze which makes them amazingly strong in proportion to their size and weight. Feather-light units are also available made from aluminum base "Ternalloy."

351

Lightweight Acid Safety Goggles

"Duo-Chem" acid safety goggles have bright yellow vinyl frames, are lightweight and comfortable. Lens is made of vinyl optical plastic. Frame is soft enough to mold in a tight seal to facial contours and has a maximum resistance to acids and alkalis. Metal hoods over screen vents offer safe, adequate ventilation. One-piece lens is made from a special vinyl acid resistant optical plastic which will not strain or discolor from acid fumes, vapors or splashes. Lens is replaceable and can be quickly and easily removed. Goggles fit over personal glasses. Manufacturer is *United States Safety Service Co.*

Use coupon, page 115, for more information



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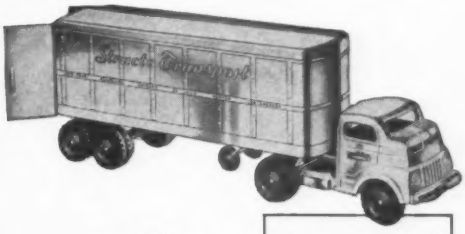
KUX

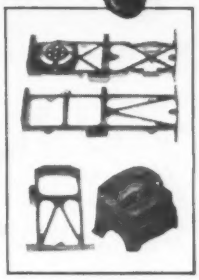
FIRST NAME IN DIE CASTING MACHINES



—used by

STRUCTO

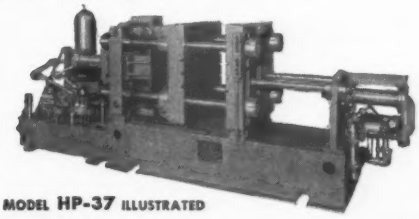
first name in realistic toys



UNGENTLE YOUNG HANDS put famous Structo trucks, trailers and steam-shovels through their "live-action" paces again and again. Toys have to be tough to take that. Structo *is* tough. Employing KUX die casting machines, Structo gets lightweight, structural castings of extra-ruggedness . . . to build toys that last a child-time of pleasure!

Is YOUR PRODUCT conditioned for the treatment it has to take? Quality die castings often make a tremendous difference in costs and saleability. KUX, first name in die casting machines, can make that difference for You!

Write for illustrated catalog showing complete line of KUX Die Casting Machines.



MODEL HP-37 ILLUSTRATED

Hydraulically operated die casting machine for production of aluminum castings.

KUX

FIRST NAME IN DIE CASTING MACHINES SELECTED BY FIRST NAMES IN INDUSTRY

KUX MACHINE COMPANY

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Represented on the West Coast by

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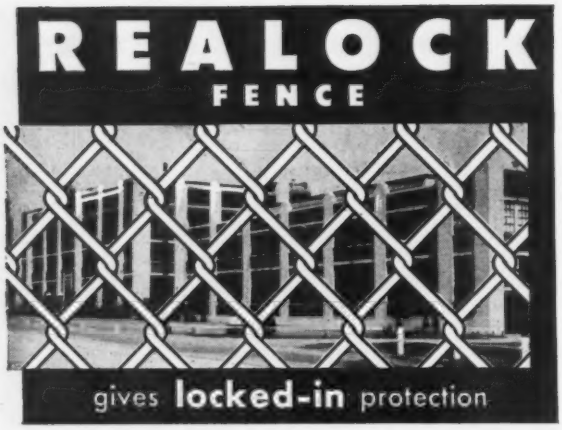

All fittings on Realock Fence have bolts so placed that nuts cannot be removed from the outside. This means that Realock Fence provides *added protection* for your grounds and property . . . effectively discourages tampering by would-be trespassers.

Strongly constructed, Realock Fence has high resistance to the elements because of a special galvanizing process . . . gives permanent protection and trouble-free service year after year. For additional information write our nearest sales office or consult your classified telephone directory.

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BRANCHES IN ALL KEY CITIES

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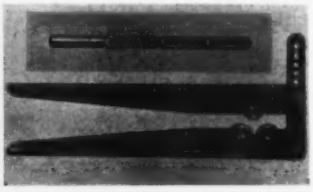
352

Versatile Hand Knurler

This hand operated knurler, manufactured by *M. P. A. Co.*, may be used with a lathe, drill press, or, if no machine tools are available, work can be held in a vise and knurler rotated around it. Since it is held in hand, like a pair of pliers, it eliminates all set-up operations formerly required. It does not require work to run dead true, as it not only knurls concentric surfaces, but surfaces that are off-center, as well. It is adjustable and will accommodate parts ranging from 5/32 to 2 in. in diameter, knurling any desired length. It will raise surface on materials from a few thousandths of an inch to 20 or 30 thousandths of an inch, depending on knurl pattern used. This permits worn and under-sized armature shafts, axles, spindles, etc., to be enlarged and used again, rather than be scrapped. Knurling permits loose-fitting pins to be enlarged and pressed into openings that would otherwise require new and large pins. Surfaces knurled with this unit may be machined after knurling and the deep-cut grooves retained on spindles and shafts to hold lubricants.



353

Small Holding Device Is Air Operated

This air operated collet holding fixture is of such compact size as to permit multiple installation on production indexing tables or where previously rapid positioning of small parts has been impossible. This unit, manufactured by *Modern-air Corp.*, uses standard shop collets 1A and 3C styles up to ½ in. capacity. Unique design permits handling of long pieces through entire fixture without interference to capacity. Overall size is 2-11/15 in. high x 3-9/16 in. base.

354

Conversion Power Package Features White Mustang Engine

A conversion power package for motor crane carriers, developed by *The White Motor Co.*, derives its greater horsepower and higher operating efficiency from its White

Have You a LUBRICATION HEADACHE?

Solve it Quickly With

MOTOR MICA
TRADE MARK REG. U. S. PAT. OFF.

ANTI-FRICTION COMPOUND
(IN WHITE POWDERED FORM)

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Packed in 5-10-25 lb. containers.

A Little Goes A Long Way!

Keeping the Wheels of Industry Cool Since 1914

SCIENTIFIC LUBRICANTS CO. 3469 N. Clark St. CHICAGO 13, ILL.

Model 280A mustang engine. This gasoline engine is a six-cylinder, 504-cu. in. unit with 4⅛-in. bore by 5-in. stroke rated 184 hp. at 3,000 rpm., with accessories to permit ready conversion.

355

This Pump Speeds Mastic Spraying Operations

"Hi-Vol" pump, manufactured by *A. Shelburne Co.*, is designed specifically for speedier handling of materials from heavy mastics to enamels and lacquers. It gives faster delivery by double action material pistons which force material through lines on both up and down stroke of air motor. Production quantities of heaviest and lightest materials are assured with a steady, even flow. Its 9 to 1 ratio permits spraying of material to greater heights. Pump is easy to handle and saves time by pumping directly from material drum. Control of pump is automatic by valve which shuts off pump and relieves pressure when gun is not in operation.

356

Adjustable Ratchet Rack

Features claimed: This ratchet rest is adjustable without bolting. Rack shelf is inserted between upright posts by fork truck. Rack can be height-adjusted at six-inch intervals. A special device automatically holds rack at desired height. Shelves can be moved anywhere on rack, solving many space problems. Rack comes in three models: standard, heavy duty and extra heavy duty.

Available from: Borroughs Manufacturing Division of American Metal Products.

Use coupon, page 115, for more information

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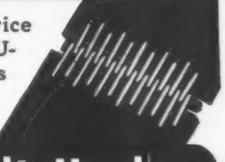
for Better Belt Joints

To keep belts in service longer, use only GENUINE Clipper Belt Hooks applied with Clipper Belt Lacers.



use Clipper Belt Hooks

Clipper Hooks are made of the finest quality wire—BETTER than ever before—produced for our exclusive use. Hooks hold with firm, sure grip—give longer satisfactory service.

and Clipper Belt Lacers!

The Clipper No. 9 Portable Lacer laces belts up to 6 inches wide in one quick, easy operation. Under powerful pressure hook legs are embedded flush with the surface of the belt and points clinched, making a perfect joint. Phone your mill supply jobber for a demonstration!

CLIPPER BELT LACER COMPANY, GRAND RAPIDS 2, MICHIGAN, U.S.A.

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THE WEST ON ITS WAY

ARIZONA

VACU-BLAST BUILDS — Vacu-Blast Co., Inc., starts construction on its new Belmont factory. Formerly sub-contracted machining and sheet metal work will be handled at the new plant. Executive offices remain at 350 Peninsular Ave., San Mateo.

ARIZONA ZONOLITE—Glendale gets a new California Zonolite Co. vermiculite ore processing plant.

AIRCRAFT ACQUISITION—The Anderson Aviation Co., Piper airplane dealer and maintenance shop operator at Sky Harbor, purchases parts and repair business of Arizona Airmotive, Inc. Transaction involves approximately $75,000. Arizona Airmotive will continue to represent Beechcraft planes in sales and operate franchise for charter air service in Arizona.

RESEARCH CENTER OPENS

New $8,000,000 scientific research center for Union Oil Co. is now in operation near Brea.

CALIFORNIA

U. S. RUBBER STRETCHES—U. S. Rubber Co. plans to build its third Southern California factory on 53 acres of land just purchased in Santa Ana. The 170,000 sq. ft. plant, to be constructed when equipment for building and manufacturing is available, will manufacture foam rubber.

DOUGLAS EXPANSION PLAN—Douglas Aircraft Co., Inc., has option to lease U. S. Steel's Los Angeles property at 190th Street and Normandie Avenue, consisting of 200 acres of land and some buildings which were used by Alcoa during World War II. With the property available to Douglas for defense production expansion, U. S. Steel plans to concentrate on modernizing and improving its Torrance Plant.

STANDARD EXPENDITURES—Standard Oil Co. of California plans to spend around $240,000,000 on capital and development and exploratory expenditures this year. Funds coming from business operations together with funds on hand will be used to finance this program which represents largest outlay of any year in company's history.

INGOT INCREASE—Seattle, South San Francisco and Los Angeles plants of Bethlehem Pacific Coast Steel Corp. produced a total of 830,846 net tons of ingots in 1951, which represents an increase of 32% over past yearly records.

CANE IS ABLE—Hawaiian Sugar Planters' Association has established a research project, with offices in San Francisco, for finding new uses and markets for by-products of sugar cane. Facilities in Hawaii and on mainland will be used to find new ways of using the 1,000,000 tons of bagasse and 260,000 tons of cane molasses produced annually by the Hawaiian sugar industry.

TIMBER TIDINGS—Construction of a $1,500,000 plywood mill near Edgewater is planned by a new cooperative, Pacific Coast Plywood Association.

NORTHROP AIRCRAFT AND WESTERN GEAR WORKS OPEN NEW PLANTS IN CALIFORNIA

U. S. Army Ordnance Corps fire control devices are being produced at the new Anaheim Division of Northrop Aircraft, Inc., less than three months after ground was broken for building. Full production will be reached during this year. Northrop leases the factory from Marda Corp.

Western Gear Works opens its new Belmont plant in San Mateo County industrial district near Bayshore Highway. Machinery used in mass producing gears for defense equipment, including new type Army vehicles, is being installed. Limited production is carried on at present, but full capacity is expected this year.

Capacity will be around 6,000,000 sq. ft. monthly, and employment will be nearly 300.

READ TAPE—Printed Cellophane Tape Co., Los Angeles, moves to a new plant at 521 North La Brea. Facilities include complete art and composition departments, special equipment for perforating and slitting self-adhesive tapes, plus research facilities for government projects.

CONVAIR GOES DUTCH—KLM Royal Dutch Airlines and Garuda Indonesian Airways (operated under contract to KLM) have jointly ordered 14 Convairliner 340's. This brings total sales for this twin motor transport to 140. When present orders are delivered, Convairliners will serve more world cities than any other modern transport.

AN URGE TO MERGE—T. W. & C. B. Sheridan Co., New York, and Gray Engineering Co., Redondo Beach, combine to form a new West Coast engineering firm known as Sheridan-Gray, Inc. New company, which has offices at 131 North Benita Ave., Redondo Beach, is engaged in designing, engineering and manufacturing special machine tools for aircraft industry.

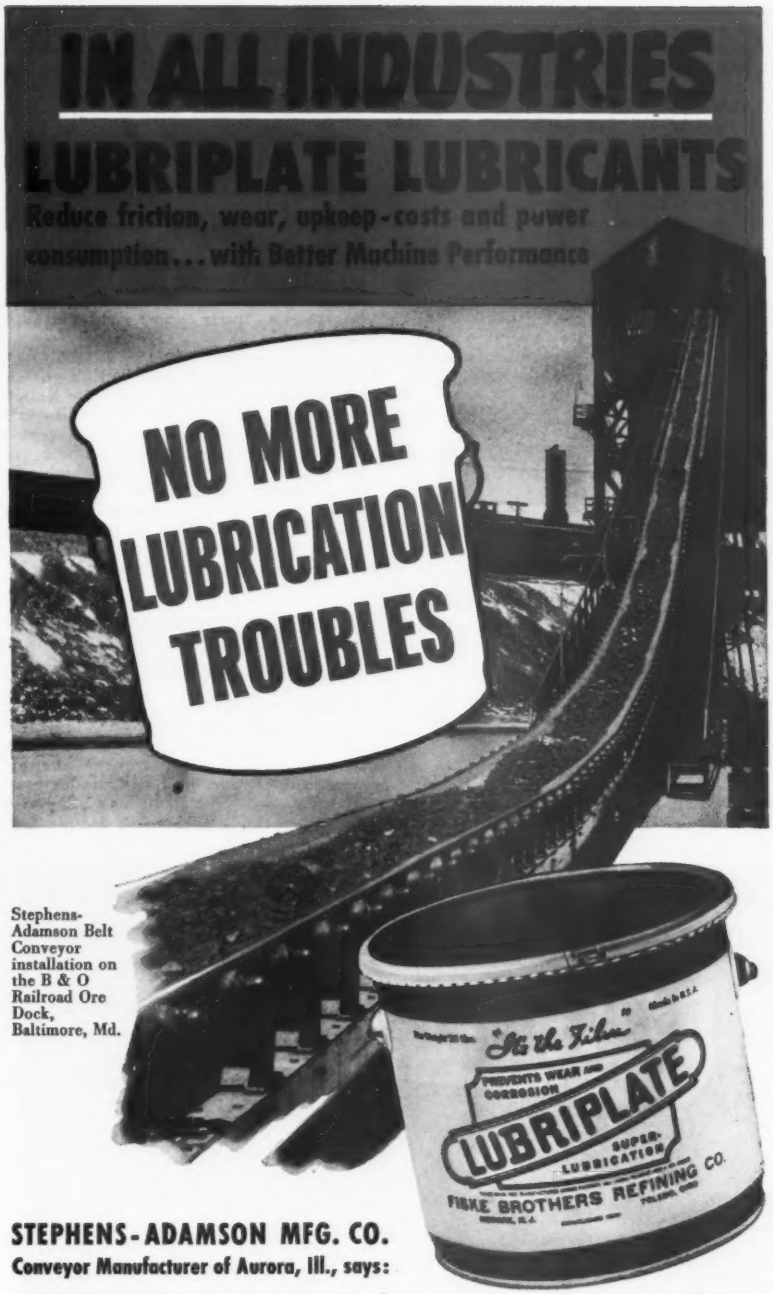
NEW SET-UP FOR SUPERWELD

Superweld Corp. (formerly of Glendale) moves into its new building at 6840 Vineland in North Hollywood. Firm is engaged in electric furnace brazing, stainless steel and non-ferrous, scale-free annealing scale-free, high permeability annealing.

CHEMICAL COMPANY CONSTRUCTION—Monsanto Chemical Co. plans on building a 250-ton sulfuric acid plant at Avon. Plant will utilize waste sludge and hydrogen sulfide piped from Tide Water Associated Oil Co. refinery. Monsanto and Tide Water will have joint ownership of this plant.

KAISER COUNTS ITS BLESSINGS—Kaiser Steel Corp., Oakland, reports that 1951 production of steel ingots in its mills amounted to 1,317,643 tons, or an increase of 15% over 1950. Firm also produced 963,711 tons of finished steel products, which is an increase of 17% over last year. Kaiser's two blast furnaces at Fontana produced 921,752 tons of pig iron, 40% more than last year; while its Riverside County iron ore mine produced 1,325,236 tons of iron, or 42% more than in 1950.

KNAPP CHANGES HANDS—Group of Southern California businessmen headed by H. L. Oppenheimer now own James



Stephens-Adamson Belt Conveyor installation on the B & O Railroad Ore Dock, Baltimore, Md.

STEPHENS-ADAMSON MFG. CO.
Conveyor Manufacturer of Aurora, Ill., says:

"LUBRIPLATE Lubricants satisfy the "one-shot" requirements of our conveyor idlers. When introduced through the fitting on either side of the idler, LUBRIPLATE effectively lubricates each bearing in turn and flows through the hollow shaft to the next bearing. We do not know of a single case of bearing trouble through faulty lubrication where LUBRIPLATE has been used."

LUBRIPLATE Lubricants are available from the lightest fluids to the heaviest density greases. There is a LUBRIPLATE Product best for your every lubrication requirement. Let us send you case histories of savings that others in your industry are making through the use of LUBRIPLATE Lubricants. Also packed in handy tubes for portable tools, guns, fishing reels, lawn mowers and household uses.

LUBRIPLATE DIVISION
Fiske Brothers Refining Company
Newark 5, N. J. Toledo 5, Ohio

Dealers Everywhere...
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LUBRIPLATE *The Modern Lubricant*

H. Knapp Co., Los Angeles. Firm makes industrial heat treat furnaces. Manufacturing operations will expand shortly.

GALVANIZING — Emsco Derrick & Equipment Co., manufacturer of oil drilling and production equipment, is modernizing its Los Angeles galvanizing plant to increase capacity about a third. This work, to be completed next August, will cost approximately $375,000.

ORDERS FOR RYAN—General Electric, Continental Motors, Boeing, Consolidated Vultee, Douglas and Fairchild have given Ryan Aeronautical Co. $6,000,000 in orders for airframe components and aircraft engine accessories, raising Ryan's backlog to more than $46,000,000.

COLORADO

FLUORSPAR FLOURISHES—Reynolds Mining Co. buys Poncha Springs fluorspar mine from Fluorspar, Inc. Property, which includes 90 acres, a flotation plant and 22 mining claims, will produce a large portion of the fluorspar used by Reynolds in making synthetic cryolite.

IDAHO

SUNSHINE SINKS SHAFT—Sunshine Mining Co. plans to sink its #5 shaft near Kellogg to 4,000-ft. level in 1952. This step in the mine's development will bring #5 shaft to 1,300 feet below sea level.

MONTANA

NEW PLANING PLANS—Roger Motichka and Hy Van Allen complete purchase of Northwest Lumber, Inc.'s planing mill and sawdust burner. New firm, located west of Whitefish will conduct operations under name of Whitefish Lumber Co.

COPPER PROJECT PROGRESS—Anaconda Copper Mining Co.'s new Kelley shaft, now sunk to 600 ft., will start copper production from the Greater Butte project about April 1. Plans are for a 6,000-ton daily output which will be gradually increased to 15,000 next year. Rock between copper bearing veins will be extracted by block-caving operation, supplementing regular mining operations in other parts of the area.

NEVADA

GET THE LEAD OUT—Lippincott Lead Co., consisting of new mine, mill and smelter operations, is established at Bonnie Clare in Nye County. Smelter, now in operation, and mill, under construction, will give small lead miners in the out-of-touch area a fine ore market.

Alabama-California mining equipment and buildings, recently bought, will be moved from Penryn, Calif., to the Nevada operation.

IRON GOES JAPANESE—Plans for importation of 2,000,000 tons of Nevada iron ore are being made by a Japanese trading company. Of 230,000 tons called for in the present contract, 60,000 tons of ore are now in Japan.

KAISER BUYS 'ER—Kaiser Aluminum & Chemical Corp. purchases Baxter fluorspar mine from H. W. Gould & Co. Output of the mine, located near Fallon, will be employed in Kaiser's expansion program for aluminum.

MORE MIGHT FOR HUSITE—Husite Corp., subsidiary of Hughes Aircraft Co., has purchased a piece of land near Las Vegas to construct a defense plant. Hughes recently started construction on a defense plant in Tucson, Ariz.

NEW MEXICO

AEC FONDA ANACONDA—Uranium ore processed in plant that Anaconda Copper Mining Co. plans to build near Grants will be sold to U. S. Atomic Energy Commission. Construction on new plant starts now and actual operations should commence about April 1953. Commission agrees to buy plant's U308 production for a period of five years.

NAVAJO NEGOTIATIONS — Navajo Uranium Co., Albuquerque, is swaptalking with U. S. Atomic Energy Commission for a $2,750,000 uranium ore processing plant to be built at Shiprock, New Mexico.

OREGON

SWAN ISLAND SWITCH—Fought and Gray, Inc., steel fabricator and miscellaneous iron products manufacturer, moves to larger quarters on Swan Island, Portland. New offices and shops will provide greater facilities to meet demands of a rapidly increasing business. Over 40,000 sq. ft. of shop space are now available.

TALES FROM OREGON WOODS—Fir Products, Inc., new lumber remanufacturing plant located between Coquille and Myrtle Point, will start work soon. Manufacturing plant and fuel storage bin have been completed and dry kilns will be constructed shortly.

MILL BUILD BILLED—J and W Lumber Co. will shortly begin construction on an all-electric fir lumber mill at Orick. Plant will cut about 100,000 ft. of lumber per eight-hr. shift. Plans for a planing mill are also being made.

CHAPCO CONSIDERS CONSTRUCTION — Chapco Co., Corvallis, has taken option on an industrial site in Eureka and may build a hardboard manufacturing plant there.

VOIT'S RUBBER VENTURE — W. J. Voit Rubber Co., Los Angeles, has acquired a 16,000 sq. ft. building in Portland for establishment of a tire re-

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EST. 1920

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HUNTINGTON PARK

pair materials and camelback manufacturing plant. Over $300,000 worth of machinery including three 60-in. rubber mills, one 8-in. extruder and auxiliary equipment will be installed. Plant will have production capacity of approximately 500,000 lb. of tire rubber per month.

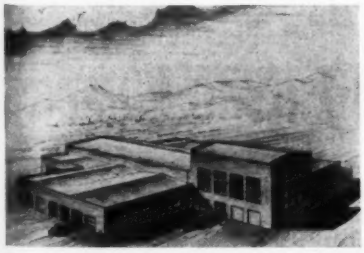
FIR BEAMS GO FUR

Six glued-laminated fir beams made by Timber Structures, Inc., Portland, are enroute to Litchfield, Ill., where they will serve as roof beams for a new school gymnasium. Beams, largest and heaviest ever made, are each 97 ft. long and weigh 7½ tons each.

PINE FINE FOR TOYS—Gray & Hanson Co., Lakeview, starts toy manufacturing business using scrap pieces of top grade ponderosa pine for toys including hobby horses, stilts, rocking horses, rocking boats and saddle desks.

UTAH

SALT LAKE SITE SET



Union Pacific Railroad Co. has begun preparing a location in its Salt Lake yards for diesel repair shops project amounting to $5,600,000. Shops, to be made of reinforced concrete block and glass brick, will be used for maintenance work and repairing of diesel power and gas turbine electric locomotives.

ASARCO STARTS SEARCHING—American Smelting and Refining Co. leases land for 30 years near Marysvale from the Marysvale Uranium Co. Active search for uranium ore will commence with a geological survey July 1.

CLARITE PLANS TO EXPAND—Clarite Batteries, Inc., plans a $50,000 production facility expansion in South Salt Lake. A battery developed by T. J. Clark interests is now sold in Western states by this firm.

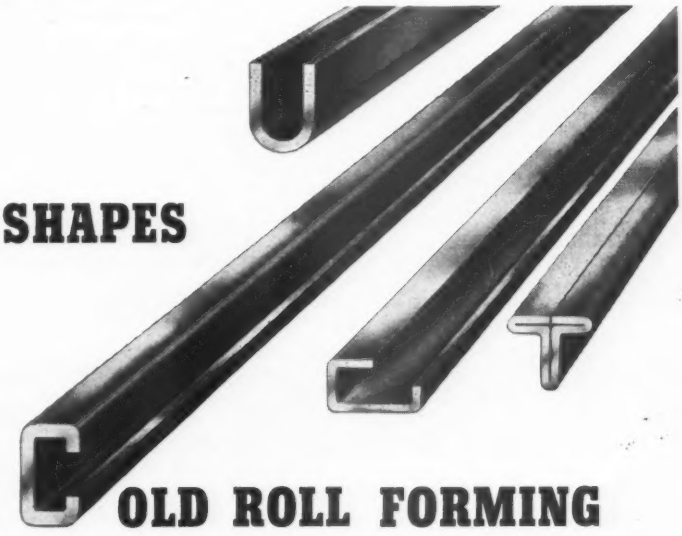
LUCERNE LAUNCHES PLANT — Lucerne Milk Co., division of Safeway Stores, Inc., plans construction of a $450,000 plant in Salt Lake City. Facility is to provide Safeway Store milk in eastern Nevada, Utah, and perhaps Wyoming.

TUNGSTEN TREATMENT — Vitro Manufacturing Co. and the Defense Materials Procurement Agency are considering establishment of a $5,000,000 tungsten treatment plant in Salt Lake City. Plant would be at the Vitro Chemical Co. operated uranium mill, 600 W. 33rd South, and would be used to "upgrade" Intermountain produced tungsten concentrates.

NEW PARK SWAPS STOCK — New Park Mining Co. will exchange 20,000 shares of New Park stock with Troy Mining Co. for its 155,744-acre claim adjoining New Park's holdings near Park City.

MANGANESE—King Manganese Corp., Houston, Texas, opens branch office in Kanab and starts mining manganese ore in Kane County. Plans include open pit mine operations and establishment of a simple beneficiation plant which will produce daily about 20 tons of high grade manganese ore.

PIPE LINE PIP—Continental Oil Co. and Sinclair Oil Corp. will build an $8,000,000 products pipe line 310 miles



SHAPES

COLD ROLL FORMING

For years the west coast, and especially the Bay Area, has needed a cold-roll forming service to produce shapes to meet particular designs and specifications. Clingan & Fortier now offers this service to Western Industry. You can now have continuous rolled formed sections made to your order. Rolled sections reduce fabrication, improve products and overcome many production problems.

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LOgan 5-5414

from Sinclair, Wyo., to Salt Lake City. Daily capacity of line will be 12,000 bbls. of gasoline, diesel oil, stove oil and other products. Greater part of fuel will move from Salt Lake City to Pacific Northwest.

MULTI-MILLION GAS DEVELOPMENT—Morgan-Walton Oil & Gas, Inc. and the Three States Natural Gas Co. sign contract for multi-million dollar development of Carbon, Emery and Sanpete County natural gas properties. If wild-cat drills are successful, a minimum 20-well program is planned. Anticipated production is allocated to Utah Natural Gas Co.

WASHINGTON

WET AND DRY DEPT.—Pacific Car & Foundry Co., which recently acquired the Everett plant of Pacific Shipbuilding & Dry Dock Co., will build a large number of amphibious vehicles for U. S. Navy. Everett plant was opened in November 1951 and has employment total of about 2,650.

METALLIC MURMURS—An increase of 40,000,000 lb. of pig aluminum a year is planned for Reynolds Metals Co.'s plant at Longview. At present, plans are delayed due to lack of power from Bonneville Dam.

BOAT BUILDING BRIEF—Puget Sound Bridge & Dredging Co. will build for the U. S. Navy an inshore fire support ship, latest development in craft for rocket launching. Ship, to have geared turbine propulsion, will be a 1,200-ton standard displacement vessel. Construction should start about June 1.

EXPLORATION STATION—Spokane will be the location for Kennecott Copper Corp.'s Pacific Northwest exploration office. Studies of mining properties in Metaline and Coeur d'Alene mining districts will probably be made by company.

PIPE PLANT PLANNED — Auburn is site of United Concrete Pipe Corp.'s anticipated $900,000 industrial plant to be built near Army's Auburn General Depot. Building should be completed with plant operating full speed ahead this year.

LONGVIEW LUMBER LEASE—Aborigine Lumber Co., Longview, arranges for lease of Pete Gibney property near Fort Bragg. Full scale woods and mill operation of the timber holdings, consisting primarily of Douglas and white fir, will start soon.

WORD FROM HANFORD—By April 1, construction management at Hanford Works passes from hands of General Electric Co. to Atomic Energy Commission. Action leaves GE free for concentration on research, development, design and operation phases of plant facilities. GE will occasionally handle architect-engineer-management services on given construction projects and will provide complete scoping and design specifications of certain process plants plus design, procurement and inspection of those units.

WYOMING

SPONGE IRON PLANT CLOSED — Bureau of Mines' sponge iron plant in Laramie is shut down by Government as result of $75,000 fire Dec. 13, 1951.

CAPITAL COLLECTED FOR WOOL PLANT—Collection of initial required capital of $1,000,000 for proposed Rawlins wool processing plant gets off to good start with $100,000 contributed by several Rawlins sheep men.

RAIL RE-ROUTED — Union Pacific Railroad starts construction on $16,000,000 42-mile line between Cheyenne and Dale Creek. Project is scheduled for completion by end of 1952.

HYDROGENATION SITUATION—Suggested as site for proposed half billion dollar coal hydrogenation plant are Hanna and Carbon coal bearing basins east of Rawlins.

NEW SODA ASH PLANT—Westvaco Chemical Div. of Food Machinery & Chemical Corp. receives certificate of necessity for $16,300,000 for building a soda ash plant. Structure is to be close to mine shaft for use of trona as raw material.

MONOLITHIC NEGOTIATIONS—Monolith Cement Co. seeks to purchase or lease an alumina plant located four miles south of Laramie. Plans are to take over operation within three months after plant is completed. Tentative completion date is set for July 1.

Notes on Quality LIGHTING:
Here in the West the installation assuring maximum lighting efficiency with minimum service and maintenance is, by every standard of comparison, SMOOT-HOLMAN. The hallmark of quality in better buildings is the presence of SMOOT-HOLMAN equipment.
The New D-P Seal-Lux, pictured above, is a vapor-tight fluorescent luminaire built for high efficiency and rugged service life under the most exacting conditions.
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2 D-P Line-Light
3 Constellation Slimline fluorescent
4 Educator incandescent
5 RLM Standard Dome Reflector
6 The Master floodlight
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MAKES TOUGH JOBS EASY!

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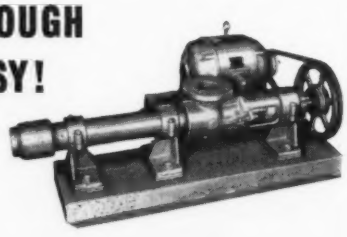

R & M MOYNO PUMPS

Pumping problems? You can end them with amazing R & M Moynos. Abrasives, chemicals, thick and heavy slurries—Moynos move virtually anything that will push through a pipe, from liquids to non-pourable pastes. They will pass particles and solids in suspension; self-prime with nearly perfect vacuum; deliver positive pressures to 1000 p.s.i. without pulsation. And Moynos do all this with only one moving part! A single-helical rotor within a double-helical stator creates continuous seal lines that form "progressing cavities" as the rotor revolves.

You name it—the Moyno will pump it! Write TODAY for information. Bulletin 30-AW.

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Steel Statistics . . .

STRUCTURAL SHAPES AND PLATES

As of January 1951
Source: American Iron & Steel Institute

COMPANIES	ANNUAL CAPACITY (Net Tons) Structural Shapes (Heavy)	Plates Sheared	Plates Universal
Bethlehem Pac. Coast	98,000	.....	12,000
C. F. & I.	52,000	7,000	.....
Kaiser Steel	60,000	216,000	25,000
Columbia Steel	8,900	.....	.....
Geneva Steel	352,000	528,000	.....
Total	570,900	751,000	37,000
STATES			
California	130,900	216,000	25,000
Colorado	52,000	7,000	.....
Utah	352,000	528,000	.....
Washington	36,000	.....	12,000
Total	570,900	751,000	37,000

HOT ROLLED SHEETS

As of January 1951
Source: American Iron & Steel Institute

	ANNUAL CAPACITY (Net Tons)
Kaiser Steel Corporation	43,000
Columbia Steel Div., U. S. Steel	317,040
Total for California	360,040

HOT ROLLED STRIP

As of January 1951
Source: American Iron & Steel Institute

COMPANIES	ANNUAL CAPACITY (Net Tons)
Colorado Fuel & Iron Corporation	600
Kaiser Steel Corporation	62,000
Columbia Steel Div., U. S. Steel	16,020
Geneva Steel Div., U. S. Steel	715,000
Total	793,620
STATES	
California	78,020
Colorado	600
Utah	715,000
Total	793,620

WIRE RODS

As of January 1951
Source: American Iron & Steel Institute

COMPANIES	ANNUAL CAPACITY (Net Tons)
Bethlehem Pacific Coast Steel Corp.	63,000
Colorado Fuel and Iron Corporation	144,000
Columbia Steel Div., U. S. Steel	219,230
Total	426,230
STATES	
California	282,230
Colorado	144,000
Total	426,230

MISCELLANEOUS FINISHED HOT ROLLED PRODUCTS

As of January 1951
Source: American Iron & Steel Institute

COMPANY	ANNUAL CAPACITY (Net Tons)
Colorado Fuel and Iron Corporation	30,800

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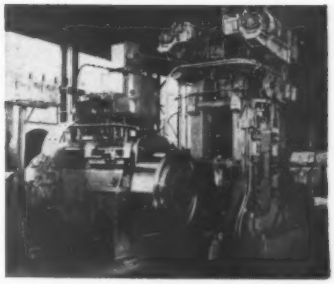
Calstrip

"THE WEST'S FIRST COLD ROLLED STRIP MILL"

COLD ROLLED STRIP STEEL

Calstrip's new four-high cold reduction mill can help you cut production costs. Plan ahead... schedule next quarter's requirements in advance with Calstrip. Have precision rolled strip steel processed to your exact specifications.

Newly expanded mill and annealing facilities now enable Calstrip to offer an increased range in sizes...from .010" to .125", widths up to 13". For strip steel of any temper—or with special edges—plan ahead with Calstrip...save at mill prices.



● Our complete services include: rotary slitters, roller leveler and shear, cold reduction mills, and bright annealing furnaces.

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YUBA-Schrock sprockets are flame cut from steel plate. Patented cam-generated action eliminates variations—every tooth in sprocket is same size and shape. "Special" sprockets with "non-standard" number of teeth readily *cut to order* without penalty charges. Most emergency orders filled in 24 hours.

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WESTERNERS AT WORK

California

CARL L. HOEBNER named general manager West Coast Division of *Trailmobile, Inc.*, Berkeley. Hoebner was formerly manager of that company's mid-Central Division.

Reinforced Plastic Consultants & Engineers, Gardena, assigns SAMUEL S. OLEESKY as chief engineer, research and development division.

Axelson Manufacturing Co., Los Angeles, elects VICTOR MANCUSO as executive vice president.

Hunt

Crown Zellerbach Corp. elects REED O. HUNT as vice president. Hunt, who has been with this company for 24 years, was assistant general manager of manufacturing before this advance. E. W. ERICKSON and P. T. SINCLAIR were elected assistant vice presidents of the company. New resident manager of *Crown Willamette* paper converting division at San Leandro is D. S. CONEY. RICHARD A. MCDONALD, chairman of Crown's executive committee, has been named assistant administrator in charge of Industrial and Agricultural Equipment Bureau for *National Production Authority*.

Bronzan

B. BRONZAN is named vice president and general manager of *Adel Division of General Metals Corp.* He was formerly associated with *Baash-Ross Tool Co., Union Iron Works* and *Consolidated Steel Corp.*

James B. Lansing Sound, Inc., Los Angeles, names GEORGE HALKIDES as general manager and JOHN TANNER as chief engineer in speaker division.

PAUL G. JORDAN transfers from sales department of *Vulcan Foundry Co.*, Oakland, to become plant superintendent, succeeding ANDREW M. ONDREYCO, resigned.

KEITH A. FITCH, one-time member of the Food and Drug Administration staff on the Pacific Coast, later associated with *Wm. J. O'Connell* in a study of fruit and vegetable cannery wastes, and subsequently a consultant in the sanitation field in San Francisco, has gone to Atlanta to become executive director of the *Orkin Institute of Industrial Sanitation*.

HERBERT F. LUNDSTROM is named manager of *American Can Co.'s* new Stockton plant. He is succeeded by MERLE L. SMITH as Oakland plant manager.

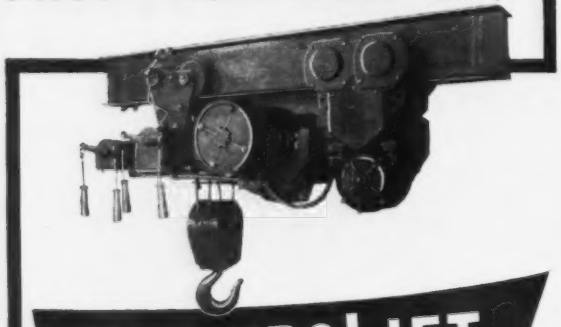
General Petroleum Corp. names ROBERT E. FRIEDMAN as assistant to executive vice president. New public relations representative for this firm is EDWARD F. STOUT.

Murray

WILLIAM MURRAY joins *C. B. S. Steel & Forge, Inc.*, Los Angeles, as product engineer.

DON L. WALTER, manager engineering and manufacturing, and JOHN A. DRAKE, chief engineer, *Marquardt Aircraft Co.*, Van Nuys, have been appointed to technical subcommittees of *National Advisory Committee for Aeronautics*. Walter will serve the subcom-

PRODUCTION PICK-UP:



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Watch your production pick up with these time-saving, manpower-saving hoists. You can move materials faster, smoother, quieter with ElectroLift.

Wide variety of one-man models, for safe movement of loads up to 6 tons. Available with push-button control for pin-point accuracy.

For further features write for Bulletin 36, or consult your ElectroLift representative listed in telephone directory.

ELECTROLIFT

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Adjudged One of the Finest Installations in the United States . . .

Moore Dry Dock Company installs huge Cocoa Butter Press in Guittard Chocolate Company's immaculate San Francisco plant. The installation of this tremendous press consisted of installing steam liquid pumps, a steam hydraulic pump, cocoa butter and cocoa liquor holding tanks and leveling the gigantic press on concrete foundations as well as manufacturing and installing all necessary piping.

MOORE
DRY DOCK
COMPANY

INDUSTRIAL
MACHINERY
DIVISION

FOOT OF ADELINE STREET
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mittee on engine performance and operation; Drake the subcommittee on internal flow.

DR. WM. HIRSCHKIND, research director of *The Dow Chemical Co.'s* western division,

Heitz

Hirschkind

is upped to position of technical advisor to president. He is succeeded by ROBERT G. HEITZ.

Promotions at *Lane-Wells Co.* include D. S. JEPPSON as senior vice president; MORTON T. HIGGS as vice president in charge of field operations and sales; DR. RUSSELL M. OTIS as vice president in charge of engineering research and patents; V. L. FORSYTH as chief engineer; and L. H. INGLE as controller.

C. P. DE JONGE succeeds H. A. NOBLE as general superintendent of *San Diego Gas & Electric Co.* Noble is promoted to post of vice president in charge of operation.

REY MAYNARD rejoins *Pratt-Low Preserving Co.*, Santa Clara, as executive in charge of raw products procurement. He was formerly a Pratt-Low fruit buyer, and for the last three years managed *Wenatchee Foods, Inc.*, at Wenatchee, Wash.

B. T. ROCCA, JR., vice president of *Pacific Vegetable Oil Corp.*, San Francisco, elected executive vice president.

Wilshire Oil Co. appoints FRED B. BEHRENS as vice president in charge of engineering, pipeline and storage operations, and crude-oil purchase and exchange. He will also continue his duties as manager of manufacturing.

Colorado

CRIS DOBBINS is named president of *Ideal Cement Co.*; M. O. MATTHEWS becomes executive vice president; T. W. ROSEBAUGH is new vice president Pacific division, and C. B. FLICK is treasurer.

Franz

ALWIN F. FRANZ is elected president of *The Colorado Fuel and Iron Corp.*, succeeding CARL W. MEYERS.

The American Smelting & Refining Co. promotes D. R. PURVIS, former mine superintendent of its Ground Hog unit at Vanadium, New Mexico, to position of general superintendent, replacing T. A. SNEDDEN, who is now in charge of company's Silver Bill open-pit copper mine and flotation plant

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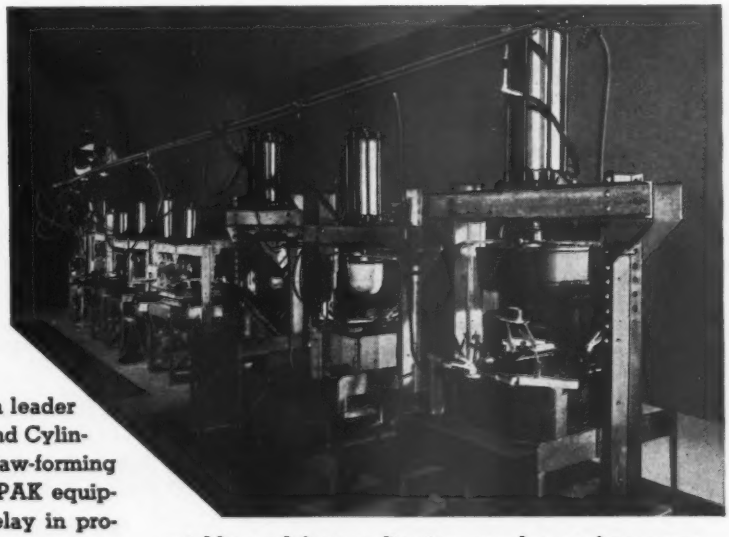
...since first installed in 1945" says user of NOPAK Valves and Cylinders



Regal Plastic Co., Kansas City, Mo., . . . a leader in its field . . . installed NOPAK Valves and Cylinders on a battery of presses used in draw-forming sheet plastics. They report that this NOPAK equipment "has never caused a moment's delay in production since first installed."

The chief requirements of this application are medium power combined with flexibility in set-up and in stroke length. Downstroke of the press, controlled at varying speeds, is followed by a *dwell* of 1 to 20 minutes and careful withdrawal of the punch from the finished part.

NOPAK Air-Cylinder Power has provided the required versatility, in that set-ups can be changed quickly, and fast application or release of pressure is easily accomplished.

For Technical Data on NOPAK Valves and Cylinders, write for Bulletin SW-1, or refer to Sweet's File for Product Designers.

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REPLACE COMPLICATED MECHANISMS WITH Ledeen CYLINDERS

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Ledeen cylinders provide positive, dependable power and pressure in straight line motion. Designed for air, oil, or water operation, they are uniform in design and construction, affording a wide number of varieties and adaptations. Ledeen cylinders are easy to install, occupy minimum space, and are built for long, economical service.

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Write for Bulletin 500

Ledeen Mfg. Co.
1600 So. San Pedro
Los Angeles 15, Cal.

at Tucson, Ariz. G. J. MATHEWS is upped to mine superintendent of Ground Hog Unit.

R. H. MILLER is new general superintendent of *American Zinc, Lead and Smelting Co.'s* No. 1 custom mill at Ouray and its Caledonia mine in San Juan County. R. H. WILHELM is mill superintendent at Ouray.

Idaho

ARTHUR C. LANKFORD is appointed chief, organization and methods branch, division of organization and personnel, Idaho Operations Office, Atomic Energy Commission, Idaho Falls. DR. BREWER F. BOARDMAN appointed chief of technical information branch, division of public and technical information.

Montana

JIM NELSON, manager of feed processing department and flax crushing plant of *Cargill, Inc.*, Conrad, is transferred to Chicago to become a member of the sales staff of *Falk & Co.*, a Cargill subsidiary. LARRY FLESCH, formerly in charge of Cargill's feed department, takes over as acting manager. LARRY LARSON is named assistant manager. J. W. PALMER, superintendent of crushing plant, succeeds Flesch.

Nevada

New superintendent of *Black Rock Desert Minerals Co.*, Sulphur, is CLAUD M. WOLGAMOTT. He was formerly foreman of *Calivada Development Co.*, Garden Valley, Calif.

Anaconda Copper Mining Co. names A. E. MILLAR as general manager and RAYMOND BURCH as mine superintendent. A. J. GOULD is plant superintendent.

New Mexico

HENRY L. JOHNSON is named engineer for testing sites in the office of engineering and construction of the Atomic Energy Commission's Santa Fe Operations Office, Albuquerque.

Oregon

GEORGE K. VAN KLEECK becomes manager of *Continental Can Co.'s* Portland plant, succeeding CHRIS HANSEN, retired.

Port of Portland appoints JAMES HEALY as adviser on drydock construction and operation, and DONALD CHARLESON is named marine superintendent.

Santiam Lumber Co., Lebanon and Sweet Home, names COLEMAN H. WHEELER as president, replacing FRED W. POWERS, deceased.

E. J. MITCHELL is elected president of *Willamette Plywood Corp.*, Eugene. New vice president is ELMER ROBYLER. ALVIN BERTELSON is secretary-treasurer.

SOL. E. SCHULTZ, chief engineer, is named temporary assistant administrator, Bonneville Power Administration, succeeding D. LORING MARLETT, resigned.

Utah

Hercules Powder Co. names JOSEPH F. TALLEY as assistant works manager of its Bacchus plant, succeeding NORMAN L. McLEOD who is being transferred to Hercules, Calif., as assistant works manager.

J. BRUCE CLEMMER, Tucson, Ariz., is named chief of U. S. Bureau of Mines' Intermountain Experiment Station, Salt Lake City, and head of Metallurgical Division in Region IV, succeeding S. R. ZIMMERLY who resigned to become director of research for Western mining divisions of *Kennecott Copper Co.*

ALBERT C. ECK, sales manager, *Utah Fire Clay Co.*, becomes assistant manager of that firm's refractory. MELVIN JOHNSON, chief clerk, is promoted to assistant treasurer. J. WILLIAM JENKINS becomes assistant superintendent.

Washington

West Coast Fast Freight appoints T. E. SAWYER as assistant general traffic manager. Sawyer headquarters in Seattle.

BRYAN L. RAUSCHERT, formerly resident engineer at *Rayonier, Inc.'s* Port Angeles division, is upped to assistant resident manager of Grays Harbor division at Hoquiam.

HARRY G. KELSEY becomes general manager of *Long Bell Lumber Co.'s* Vaughn, Oregon division, succeeding GEORGE S. HAYS, retired. THEO. A. DEAL, who has been with this firm for 30 years, and as manager of wholesale department since 1944, is promoted to assistant general manager of Longview division. CLYDE STARLING, assistant manager of wholesale department, succeeds Deal. A. J. MYERS is advanced to assistant general manager of *Gardiner Lumber Co.*, Gardiner, Oregon subsidiary; and J. E. ADAMS, formerly superintendent of planing mills and shipping, is upped to superintendent of Longview manufacturing plant.

Wyoming

E. J. HUSEMANN takes over as office manager and chief accountant for *Husky Oil Co.*, Cody.

Leaders in
ALUMINUM and STEEL
HEAT TREATING
Quality with Service
COMPLETE SALT BATH FACILITIES FOR SCALE FREE STEEL HEAT TREATING 24, 61 & 75 ALUMINUM ALLOYS A SPECIALTY
24-Hour a Day Operations — Daily Delivery Service
North American Metals Co.
(ALUMINUM HEAT TREATING)
HOLLYWOOD HEAT TREATING CO.
1046 N. Orange Drive · Los Angeles 38 · GLadstone 4108

Western TRADE WINDS

News about those who distribute and sell industrial equipment and materials

JAMES B. HOXIE becomes Western division sales manager for *Oliver United Filters, Inc.*, Oakland, succeeding PHILIP J. MCGUIRE who is appointed director of research and development for Oliver.

Hughes

Sterling Electric Motors, Inc., names JAMES R. HUGHES as manager of its recently established Denver district office.

DONALD R. WARREN joins *C. R. Strassner Co.*, Los Angeles radio and TV manufacturing representative, as salesman to cover Northern California and parts of Nevada.

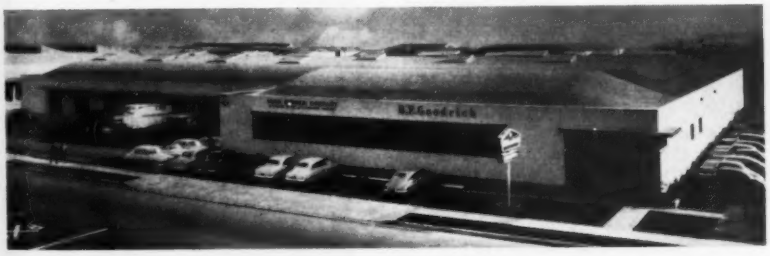
WILLIAM H. BAKER and RALPH H. EICHER, JR. have recently assumed duties as assistants in *Tide Water Associated Oil Co.'s* advertising and sales promotion department.

The Miller Company, Meriden, Conn., manufacturers of industrial and commercial lighting equipment, appoints *Manufacturers Marketing Service*, Menlo Park, Calif., as its sales representative for Southern California-Arizona area.

E. NELMES THOMAS, formerly assistant manager of sales promotion division, *Commercial Solvents Corp.*, becomes manager of *Chiksan Co.'s* new sales development department. Thomas will headquarter at company's main plant in Brea, Calif.

D. J. Murray Manufacturing Co., Wausau, Wis., appoints *Dan E. Charles Agency*, Jones Bldg., Seattle, as its representative for GRID unit heaters in state of Washington.

GOODRICH OPENS NEW WAREHOUSE IN LOS ANGELES



This new structure at 2944 East 44th St., Los Angeles, recently opened by *B. F. Goodrich Co.*, consolidates all warehousing operations for that firm in Los Angeles area. Building covers 53,420 sq. ft. Shipping docks will accommodate six trucks and four railroad cars. An additional 13,320 sq. ft. of paved area outside is provided for truck service, customer and employee parking.

Cinema Engineering Co., Burbank, Calif., names DICK HYDE as representative in Colorado, Wyoming, Utah, Arizona, New Mexico and western Texas.

New sales engineer for *Neely Enterprises'* Los Angeles headquarters is ROBERT BRUNNER, formerly with *Hewlett-Packard Co.*, Palo Alto, Calif.

Northwest Factory Agents, Inc., Seattle, now represents *Aluminum Industries, Inc.*, Cincinnati, Ohio.

DOW JONES, Los Angeles, is appointed superintendent of *Quaker Oats Co.'s* Portland operations, succeeding PAUL H. BIMMERMAN who is promoted to Western division manager, at San Francisco. He succeeds M. J. AUBINEAU who takes over as director of purchases, Chicago.

Georgia-Pacific Plywood Co. names CHARLES R. WILSON as general manager and sales manager of its newly established truss division of *C. D. Johnson Lumber Corp.*, an Oregon subsidiary.

Janca

Westlectric Castings, Inc., Los Angeles, promotes JOHN W. JANCA to position of sales manager. Janca joined this firm in 1942 as a member of production control department.

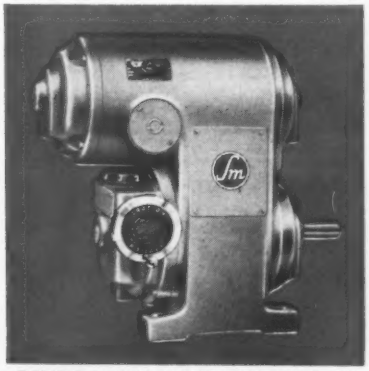
R. W. HENSEL, industrial specialist with Portland Chamber of Commerce staff since 1945 assumes management of *Frederick E. Becker Co.*, Pacific Coast manufacturers representative headquartered at Portland.

RICHARD E. PALMER is named assistant sales manager of *AiResearch Manufacturing*

A Cork Closure Mfr. Increases Production 20%

Mr. R. Vincent Torras, Vice-President of Consolidated Cork Corporation, states, "Through years of experience we have found that variable speed drive as provided by Sterling Speed-Trol has increased our production by 20 per cent. Speed-Trol has also given us the much needed control of quality of the finished product."

STERLING SPEED-TROL



GIVES YOU VARIABLE SPEED CONTROL NECESSARY FOR:

Equipment adaptation to: Sequence synchronization — operators' abilities — load variations due to differences in quantity, quality, weight, size, tension, hardness or shape of material to be processed, machined, conveyed, blended, mixed, etc.

Process control of: Temperature—viscosity—level—pressure—flow—etc.

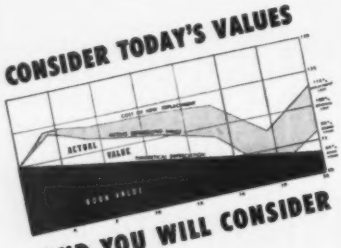
Time control of: Baking—drying—heating—cooking—pasteurizing—soaking—chemical action—etc.

With Speed-Trol you get the maximum in production, plant efficiency, quality & profit.

70 ILLUSTRATIONS showing how Sterling Electric Power Drives reduce production costs. Write for Bulletin No. A-131.

STERLING ELECTRIC MOTORS

Plants: New York City 51; Van Wert, Ohio; Los Angeles 22; Hamilton, Canada; Santiago, Chile
Offices and distributors in all principal cities



A GENERAL APPRAISAL

Hundreds of firms today are experiencing severe fire losses unnecessarily—because their insurance was written on obsolete property values. Before you buy insurance protection talk to a General Appraisal representative and find out how much less it costs to be sure. A guess is a poor substitute for a General Appraisal at the time of loss settlement.

GENERAL APPRAISAL COMPANY

SEATTLE LOS ANGELES
PORTLAND SALT LAKE CITY
SAN FRANCISCO VANCOUVER, B. C.

where to buy....

TAYLOR spiral weld pipe

Call **REPUBLIC SUPPLY**

Co., Los Angeles. WILLIAM J. HANLON assumes Palmer's former duties in connection with processing of customer orders.

C. L. HEWITT, JR., joins *Dallman Co.*, San Francisco, as manager of plumbing and heating division.

Sauereisen Cements Co., Pittsburgh, Pa., appoints *Montgomery Brothers* as its exclusive West Coast distributor. Montgomery Brothers maintains offices and warehouses in San Francisco, Los Angeles and Portland.

HERBERT E. FRYER is named manager of sales for newly established Denver sales district of *Columbia-Geneva Steel Division of U. S. Steel Co.*

West Coast Fast Freight advances RAY E. DIELSCHNEIDER to the newly created position of special field representative, Portland, Ore., district office. H. F. CLARKE, sales representative at Los Angeles, is promoted and transferred to Portland as sales manager.

The Duriron Co., Inc., Dayton, Ohio, opens a direct sales office at 214 North Cannon Drive, Beverly Hills, Calif. D. J. COLYER heads up new office as district manager.

A. R. Maas Chemical Co., Division of Victor Chemical Works, South Gate, Calif., names TED WADSLEY as Seattle sales repre-

Wadsley

Sanko

sentative. Wadsley was formerly a metallurgist for *Aluminum Co. of America* in Vernon, Calif. GEORGE E. SANKO takes over as San Francisco Bay Area sales representative for Maas.

H. G. KRAUS is appointed assistant national sales manager of *Gerlinger Carrier Co.*, Dallas, Ore. He was associated with *Ross Carrier Co.* before joining Gerlinger.

Carl Hirschmann Co., New York and Los Angeles, is appointed exclusive U. S. representative of *Nassovia Machine Works Hanns Fickert*, Langen Bei Frankfurt a. Main (Germany). Company manufactures machines for manufacture of dies, molds and other three dimensional forming tools.

Federated Metals Division of American Smelting & Refining Co. names JOHN V. REARDON as Seattle branch manager, and HENRY B. NELSON as Portland branch manager.

J. C. McDougall Co., Seattle, is named Washington sales representative for *Fenwal Incorporated*, Ashland, Mass. thermostat manufacturer.

Swiatek

ED SWIATEK becomes sales manager of *Diamond Machine Tool Co.*, Los Angeles.

New sales representative for *Allis-Chalmers Manufacturing Co.* in San Francisco district office is EDWARD B. GREEF.

BIG PLANS FOR WHITE MOTOR CO.

The White Motor Co. plans construction of a modern $750,000 building at 5th and Brannan Streets, San Francisco. Building will house White's Pacific Coast regional offices and San Francisco branch office. It will also contain complete repair facilities for White and other makes of commercial vehicles.

***Wilson D. Patterson,* Pacific Coast regional manager for *The White Motor Co.* (right), presents a check to *C. E. Needham,* president of Van Arsdale-Harris Lumber Co., San Francisco (left), for property for White's new regional headquarters. Standing in back from left to right are: *James C. Needham,* Van Arsdale-Harris; *C. N. Gustason* of Norris, Beggs & Simpson, realty firm; and *George Cruden,* White's San Francisco branch manager.**

California Fasteners, Emeryville, Calif., moves to new and larger quarters at 1447 Park Avenue.

Consolidated Western Steel Division of U. S. Steel Co. names P. M. COBB as vice president—sales. Cobb was formerly vice president in charge of sales for San Francisco district. RALPH W. SEELY, vice president at Maywood plant, becomes vice president and assistant to president, with division-wide responsibility for engineering, estimating and industrial relations.

Naugatuck Chemical Division, U. S. Rubber Co., opens a new and enlarged plant on Telegraph Road, Los Angeles.

PROMPT AND COURTEOUS ATTENTION ON YOUR FOUNDRY REQUIREMENTS

SPECIALISTS ALLOY AND GRAY IRON CASTINGS

GAS & DIESEL ENGINE WORK
Production & Jobbing Castings of all types

Emblem of Quality Castings
HCMFCo
Since 1898

No Job too Large or too Small

H. C. Macaulay Foundry Company

811 CARLTON STREET BERKELEY, CALIF.
BErkeley 7-2911

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CLASSIFIED SECTION

Rates are $7.50 a column inch. Copy should be sent in by the 10th of preceding month if proofs are required; by the 15th if no proofs are required.

EQUIP YOUR SHOP!

THESE GOOD USED TOOLS ARE SENSIBLY PRICED

Air Compressor, single phase	$ 125	Miller, #1½ B & S Universal MD	$1,500
Boring Mill, 4" bar, horizontal	$2,500	Miller, #3 Ingersoll vertical	$2,700
Boring Mill, 42" vertical, MD	$4,250	Radial Drill, 3', post type	$ 375
Drill Press, 2 spindle Avery, MD	$ 375	Radial Drill, 4' Hammond, MD	$ 650
Drill Grinder, 2½" capacity, MD	$ 150	Shaper, 24" Niles, travel head	$ 950
Drill Press, 20" BG, PF, MD	$ 325	Shaper, 24" Smith-Mills, MD	$1,500
Keyseater, #0 Baker, 1" capacity	$ 600	Screw Machine, #1 W & S, ⅝"	$ 225
Lathe, #608 Rivett, precision	$1,200	Screw Machine, #1 Foster, ¾"	$ 345
Lathe, QC, 10 x 4' Logan, chks.	$ 525	Turret Lathe, #4 W & S, 1½", MD	$ 975
Lathe, QC, 16 x 10' L & S, mtr.	$ 975	Turret Lathe, 3 x 36" J & L, MD	$ 950
Lathe, QC, 18 x 10' Hendey MD	$1,175		

Don't delay—phone, write or wire today!

SCHELLENBACH MACHINERY CO.

480 - 5TH STREET, SAN FRANCISCO, CALIF. — TELEPHONE DOUGLAS 2-7711

100 GENUINE 8 x 10 PHOTOS 10¢ ea

24 HOUR SERVICE!

FREE DELIVERY ANYWHERE

MADE DIRECT FROM PHOTOS (OR NEGATIVES) • 50 8 x 10 13c ea. 500 8 x 10 8c ea.

1000 8 x 10 GLOSSIES 7¢ EACH

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5000 $21 PER M. 2½¢ each in 1000 lots

SAVE THROUGH QUANTITY PRODUCTION

FOR COMPLETE PRICE INFORMATION WRITE OR PHONE:

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QUANTITY PHOTOS, Inc.

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LARGEST PHOTO REPRODUCTION PLANT IN WEST

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LOS ANGELES 36, CALIFORNIA

SCIAKY SEAM WELDERS

Two Type-PMM2T13 3-Phase 120 KVA, 440 volts, 60 cycles. Top condition. Designed primarily for welding stainless steel or aluminum. Complete specifications on request. Priced for quick sale.

W. R. AMES COMPANY

150 Hooper Street

San Francisco 7, California

IDAHO INDUSTRIAL DIRECTORY

1952 Edition, listing Manufacturers, Processors, Mines, Wholesalers, Contractors.

$2.50 Postpaid

Idaho State Chamber of Commerce

524 Idaho Bldg., Boise, Idaho

Reeves

De Laval Steam Turbine Co., Trenton, N. J., forms a subsidiary corporation, *De Laval Turbine Pacific Co.*, with headquarters at Main and Folsom Streets, San Francisco. C. F. REEVES, former West Coast manager for De Laval, is named general manager to direct this new company.

E. DIXON HEISE is appointed assistant to the manager of *Blake, Moffitt & Towne's* San Francisco Division. He was assistant sales manager, printing paper department prior to this advance. Dixon is succeeded by HERBERT M. CHISHOLM, former advertising manager. WILLIAM J. OWEN is new advertising manager.

DONOVAN A. DUTTON joins *W. P. Wooldridge Co.*, San Francisco, as sales engineer. Dutton will work out of this company's Los Angeles office.

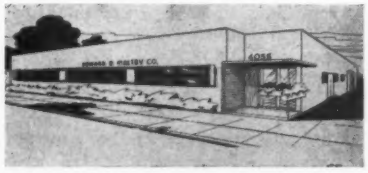
CHARLES R. BECKER, formerly sales manager at Cambridge, Mass. for *J. W. Greer Co.*, moves to the West Coast to open and manage a new Western sales office in the San Francisco area, to cover the thirteen Westernmost states, Mexico and Western Canada.

B. F. Goodrich Co. opens new sales and warehousing operations at 2944 East 44th St., Los Angeles. This move consolidates all warehousing operations in Los Angeles area for this firm.

B. F. Goodrich Chemical Co. moves its sales offices to 714 West Olympic Blvd., Los Angeles.

JOSEPH MALO, former production superintendent of *William Wallace Co.*, Belmont, takes over as vice president and sales manager.

NEW QUARTERS FOR MALTBY CO.



***Edward D. Maltby Co.* opens a new building for its Industrial Division at 4035 East 52nd St., Maywood, Calif. Building is completely fireproof, sound conditioned, has ample storage bins, and excellent equipment for moving stocks.**

Simonds Saw and Steel Co., Fitchburg, Mass., appoints *Ducommun Metals & Supply Co.*, Los Angeles, as its Western distributor. Ducommun recently increased the sales staff of its Salt Lake City branch to take care of increased business in the Intermountain states.

New location for *Miller Steel Products Co., Inc.*, is 8660 South Atlantic Avenue, South Gate, Calif.

GEORGE GLASS, former industrial engineer for *Boeing*, joins *Harnischfeger Corp.'s* Seattle staff in a sales capacity. RAY GIERSCH is transferred from Milwaukee offices of this firm to become service engineer at Seattle.

Contact, Inc., Cambridge, Mass. maker of tweezer soldering units, appoints *G. B. Miller Co.*, Hollywood, to represent it in Arizona, Nevada, New Mexico, California, and El Paso, Texas. Miller also named to represent *New London Instrument Co.*, New London, Conn.

G. B. Miller Co. recently opened a new branch at 1355 Market St., San Francisco. BENEDETTO A. CERRUTI directs operations at this new branch.

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Practical, Down-to-Earth Welding Rods
Alloys as they are supposed to be

Corrosion Resistant—
Clean metal

Strong—
Low in cracking

A. P. JOHNSTON CO.
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under all supply conditions...

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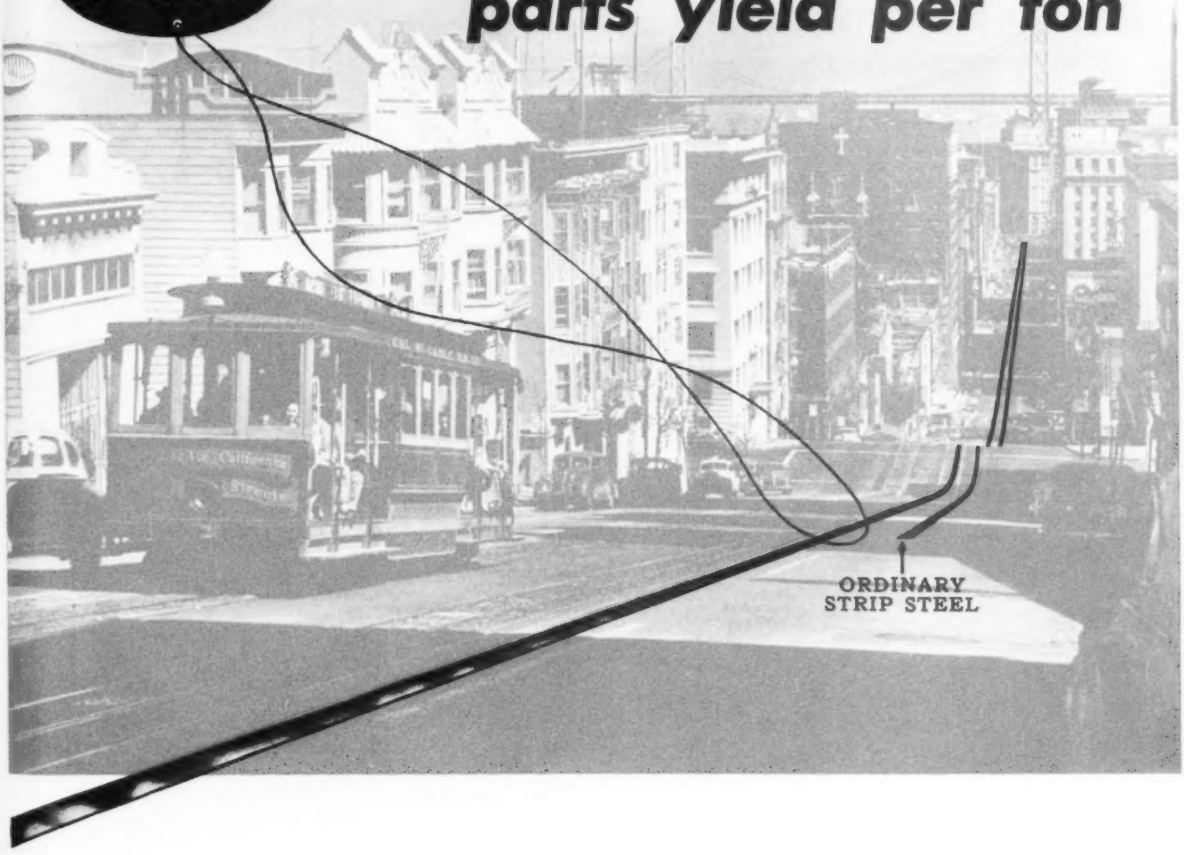
insures you *maximum parts yield per ton*



If you unrolled a 1000 pound coil of 3⅝"x.020" CMP THINSTEEL up San Francisco's famed California Street hill it would reach from Market Street to Powell—3957 feet to be exact.

If you unrolled the same weight coil of ordinary 3⅝" x .020" strip right beside it and it happened, as is often the case, to run to the high side of the tolerance—.002" oversize—it would reach only 166 feet beyond Stockton Street—almost 360 feet short of Powell.

Here is a graphic illustration of the greater parts yield per pound or per ton insured by CMP's precision rolling processes.

Next time you need flat rolled steel and want to get *most* production from each pound, check with us. Our supply situation has improved substantially and chances are we have your present requirements in stock.

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TOP SPEED At ROCK BOTTOM Cost Per Ton

In this rock products plant, a system of S-A designed and installed belt conveyors and vibrating screens handle and process aggregate fast and at lowest cost per ton. Conveyors move aggregate from receiving dump hopper through initial screening and crushing operations to final recrushing, screening, washing and grading. Various sizes and grades of rock products are then conveyed to storage for final shipment. At a centrally located elevated pushbutton control panel one operator observes and controls all operations.

"Speed up operations" . . . "Increase output" . . . "Keep handling costs at a minimum". Such were the specifications S-A engineers faced when they went to work on design of this southwestern rock products plant. The result was a conveying system engineered for fast, continuous handling that permits the plant to operate at peak capacity at moderate cost per ton.

Engineering bulk materials handling systems to reduce costs has been the work of S-A engineers for half a century. Special conditions have been met with special equipment so often that the best ideas were continuously absorbed into the Stephens-Adamson line. Today it is probably the most complete available, in types and range of equipment, and S-A engineers have adapted it in case after case with marked success to exacting specifications.

Let S-A engineers give you their recommendations for improving your bulk materials handling system. There's no obligation . . . no cost to you for this service. Write today.

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Washington Machinery & Storage
7329 E. Marginal Way, Seattle 8, Wash.

Bulk Material Handling Equipment